Series 1960, No. 25

Issued June 1965

SOIL SURVEY
DEUEL COUNTY
Nebraska

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
UNIVERSITY OF NEBRASKA
Conservation and Survey Division

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Deuel County will serve several groups of readers. It will help farmers and ranchers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; guide those who wish to plant windbreaks to protect fields and farmsteads; and add to our knowledge of soil science.

Locating Soils

Use the index to map sheets at the back of this report to locate areas on the large map. The index is a small map of the county numbered to show where each sheet of the large map is located. On the large map the boundaries of the soils are outlined, and there is a symbol for each kind of soil. All areas marked with the same symbol are the same kind of soil, whereever they occur on the map. The symbol is inside the area if there is enough room; otherwise, it is outside the area and a pointer shows where the symbol belongs.

Finding Information

This report contains sections that will interest different groups of readers, as well as some sections that may be of interest to all.

Farmers, ranchers, and those who work with them can learn about the soils in the section "Descriptions of Soils" and then turn to the section "Use and Management of Soils." In this way, they first identify the soils on their farm and then learn how these soils can be managed and what yields can be expected. In the subsection "Use and Management of Rangeland," the soils of the county have been placed in range sites. The "Guide to Mapping Units" at the back of the report will simplify use of the map and report. This guide lists each soil and land type mapped in the county, and the page where each is described. It also lists, for each soil and land type, the capability unit and range site, and the pages where each of these is described.

Foresters and others interested in woodland can refer to the subsection "Woodland and Windbreaks." In that subsection the soils in the county are grouped according to their suitability for trees, and factors affecting the management of woodland are explained.

Engineers will want to refer to the subsection "Use of Soils in Engineering." Tables in that subsection show characteristics of the soils that affect engineering.

Scientists and others who are interested will find information about how the soils were formed and how they were classified in the section "Formation and Classification of the Soils."

Students, teachers, and other users will find information about soils and their management in various parts of the report, depending on their particular interest.

Newcomers in Deuel County will be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the section "Facts About Deuel County," which gives additional information about the county.

* * * * *

The Deuel County Soil and Water Conservation District was organized in 1940. Through the district, farmers and ranchers receive technical assistance from the Soil Conservation Service in planning for the use and conservation of the soils on their farms and ranches. This soil survey was made as a part of that technical assistance. Fieldwork for the survey was completed in 1960 and, unless otherwise indicated, all statements in the report refer to conditions in the county at that time.

Cover picture: Harvest of winter wheat on the silty tablelands in northeastern Deuel County.

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SOIL SURVEY OF DEUEL COUNTY, NEBRASKA

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UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE UNIVERSITY OF NEBRASKA, CONSERVATION AND SURVEY DIVISION

DEUEL COUNTY is in the southeast corner of the Nebraska panhandle, where it adjoins Colorado (fig. 1). The county extends about 30 miles from east to west and 15 miles from north to south, and it has an area of 435 square miles, or 278,400 acres. Chappell, the county seat, is 340 miles west of Omaha, 130 miles east of Cheyenne, Wyoming, and 180 miles northeast of Denver, Colorado.

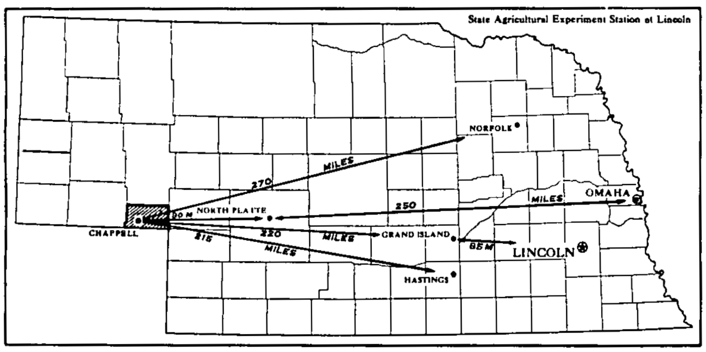

Figure 1.—**Location of Deuel County in Nebraska.**

Deuel County is agricultural. Most of the acreage is cropland that is used mainly for wheat and is subject to wind and water erosion. In addition, large areas of native range provide grazing for livestock, principally beef cattle. During favorable years the yields of crops are excellent, but generally they are limited because of a scarcity of moisture; and like other areas of the Great Plains, the county has periods of drought. Destructive rainstorms, often accompanied by hail, occur almost every year in local areas.

How Soils Are Mapped and Classified

Soil scientists made this survey to learn what kinds of soils are in Deuel County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen, and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of crops or native plants; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots of plants.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Keith and Rosebud, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural, untouched landscape. Soils of one series can differ in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that are alike except for texture of their surface layer. According to this difference in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Rosebud loam and Rosebud fine sandy loam are two soil types in the Rosebud series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil map as one unit. Such soil types are divided into soil phases. The name of a soil phase indicates a feature that affects management. For example, Rosebud loam, 0 to 3 percent slopes, is one of several phases of Rosebud loam, a soil type that ranges from nearly level to moderately sloping.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of

the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that greatly help in drawing boundaries accurately. The soil map at the back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientists have a problem of delineating areas where different kinds of soils are so intricately mixed, and so small in size, that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, Rosebud-Canyon complex.

In a few places it is desirable to show two or more soil types or soil phases, which are similar but do not regularly occur together as one mapping unit. Such groups are called undifferentiated soil groups. They are named in terms of their constituent soils and connected by "and." Bridgeport and Havre loams, 0 to 1 percent slopes, is an example of an undifferentiated soil group.

Also, on most soil maps, areas are shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Slickspots or Wet alluvial land, and are called land types rather than soils.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, and engineers. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey reports. Based on the yield and practice tables and other data, the soil scientists and other persons set up trial groups, and test them by further study and by consultation with farmers, agronomists, engineers, and others. Then, the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

After studying the soils in a locality and the way they are arranged, a soil scientist can make a general map that shows the main patterns of soils, called soil associations. Such a map is the colored general soil map at the back of this report. Each association, as a rule, contains a few major soils and several minor soils, in a pattern that is characteristic though not strictly uniform.

The soils within any one association are likely to differ in many properties; for example, slope, depth, stoniness, or salinity. Thus, the general soil map does not show the kind of soil in any particular place, but patterns of soils, in each of which are several different kinds of soils.

Each soil association is named for the major soil series in it, but as already noted, soils of other series may also be present. The major soils of one soil association may also be present in another association, but in a different pattern.

The general map is useful to people who want a general idea of the soils, who want to compare different parts of the county, or who want to learn the possible location of good-sized areas suitable for a certain kind of farming or other land use.

Deuel County has seven soil associations. Soil association 4 is on nearly level flood plains, and it contains soils that are imperfectly drained. Soil association 2 is on shallow, gravelly breaks along the major streams of the county. Soil associations 1, 3, and 6 contain benchlands, tablelands, and rolling silty uplands. Soil associations 5 and 7 consist of sandy soils of upland valleys and hills.

1. Keith-Rosebud association: Silty tablelands

This is by far the largest soil association in Deuel County. It consists of the mildly sloping parts of the uplands and occurs in two general areas that are separated by the deep valley of Lodgepole Creek. The larger area is called North Table, and the smaller, South Table.

The main soils of this association formed in silty, windblown deposits (fig. 2). The Keith soils are the most extensive and are deep, dark, and fertile. In areas where the underlying residual sandstone is near the surface, the moderately deep Rosebud and the shallow Canyon soils are dominant. These soils are mainly on the rises, the knobs, and some of the steeper slopes.

Less extensive in the association are the Richfield, Kuma, Goshen, Dawes, and Scott soils. Richfield and Dawes soils are in fairly flat, slightly convex areas. The dark-colored Kuma soils are on low-lying flats, and the dark-colored Goshen soils lie in swales and basins. Scott soils are slowly permeable and occur in small depressions that are occasionally flooded.

Nearly all this association is cultivated, mainly to winter wheat grown under dryland farming. (See cover picture.) Excellent yields are obtained under good management. Other important crops are winter barley and grain sorghum. An increasing acreage is planted to safflower, a newly introduced crop grown for the oil in the seed. Many farms are 640 acres or more in size, and farm operations are highly mechanized. Figure 3 shows a typical farmstead in the Keith-Rosebud association.

Low rainfall limits the choice of crops. Although much of the area is suitable for irrigation, water is not available. Both water and wind erosion are hazards. Flash rains

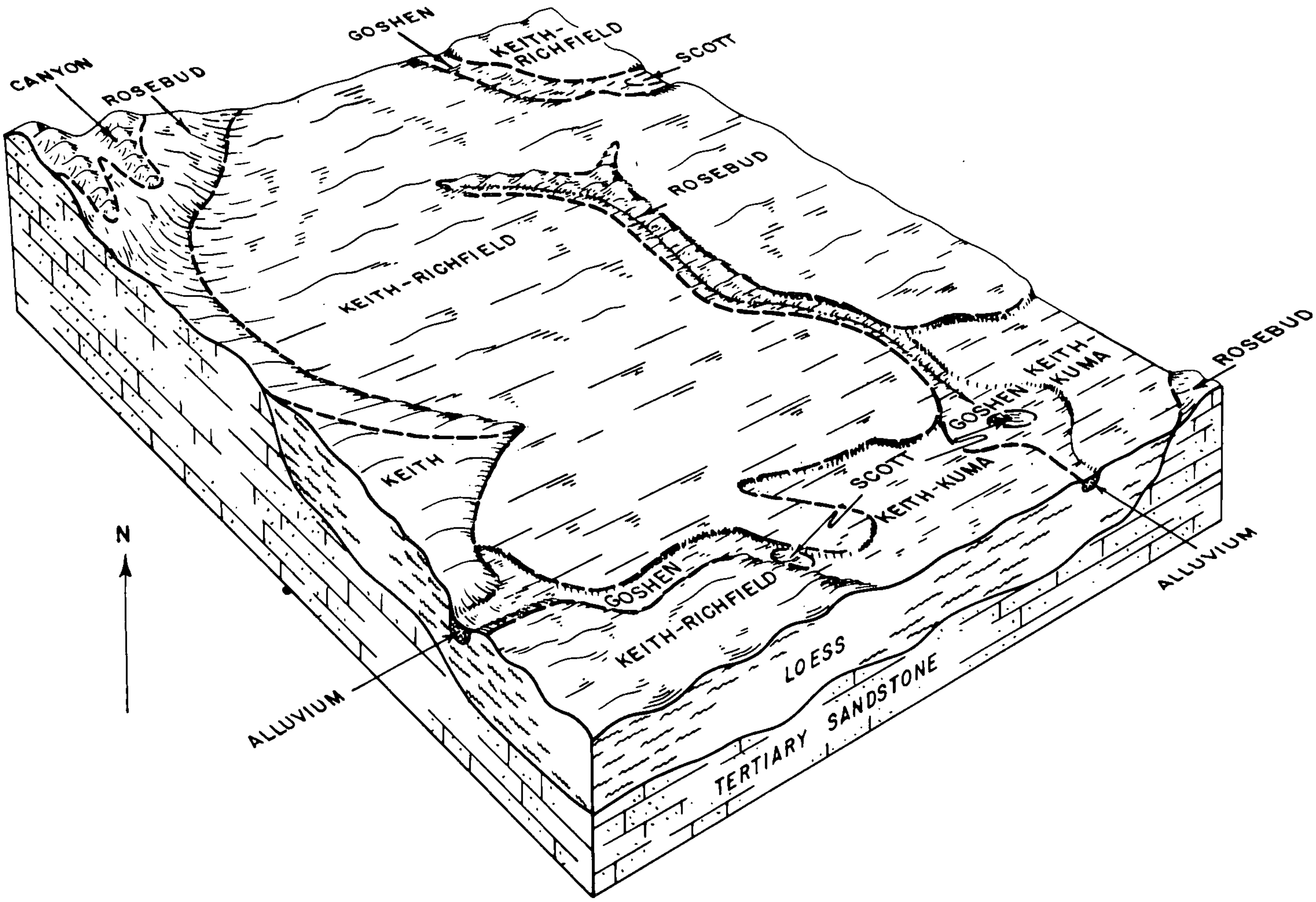

Figure 2.—**Landform and soils in the Keith-Rosebud soil association.**

damage sloping areas, and blowing is severe during droughty periods.

2. Dix-Altvan association: Shallow, gravelly breaks

This is the second largest soil association in Deuel County. It consists of sloping, gravelly areas along Lodgepole Creek, on the breaks above the South Platte River, and along the tributaries of these streams.

The major soils of the association formed in gravelly or in mixed gravelly and loamy deposits (fig. 4). The Dix, Altvan, and Chappell soils are most extensive. The Dix soils are shallow and gravelly; they occupy high, irregularly shaped knolls. The Altvan and Chappell soils lie on lower, fairly smooth slopes, and are moderately deep over gravel. The Altvan soils are silty, but the Chappell soils are sandy.

Less extensive in the association are the Canyon, Rosebud, and Keith soils. The shallow Canyon soils and the moderately deep Rosebud soils occur in scattered areas where the underlying residual sandstone is near the surface. Keith soils are loamy and fairly deep; they occupy slopes where gravel and residual sandstone are covered by several feet of loess.

The farms in this association are highly mechanized and are used for growing cash crops and for raising livestock. Many of the less strongly sloping areas are cultivated, but a large acreage is poorly suited to crops and is in native grass used for range. Most farms cover 640 acres or more.

This association produces more beef cattle than the others in the county (fig. 5). The range is grazed by brood cows all year and commonly by yearlings in summer. The

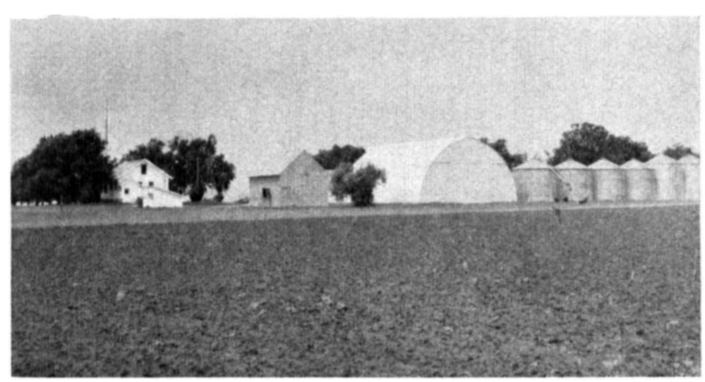

Figure 3.—**Typical farmstead in the Keith-Rosebud soil association.**

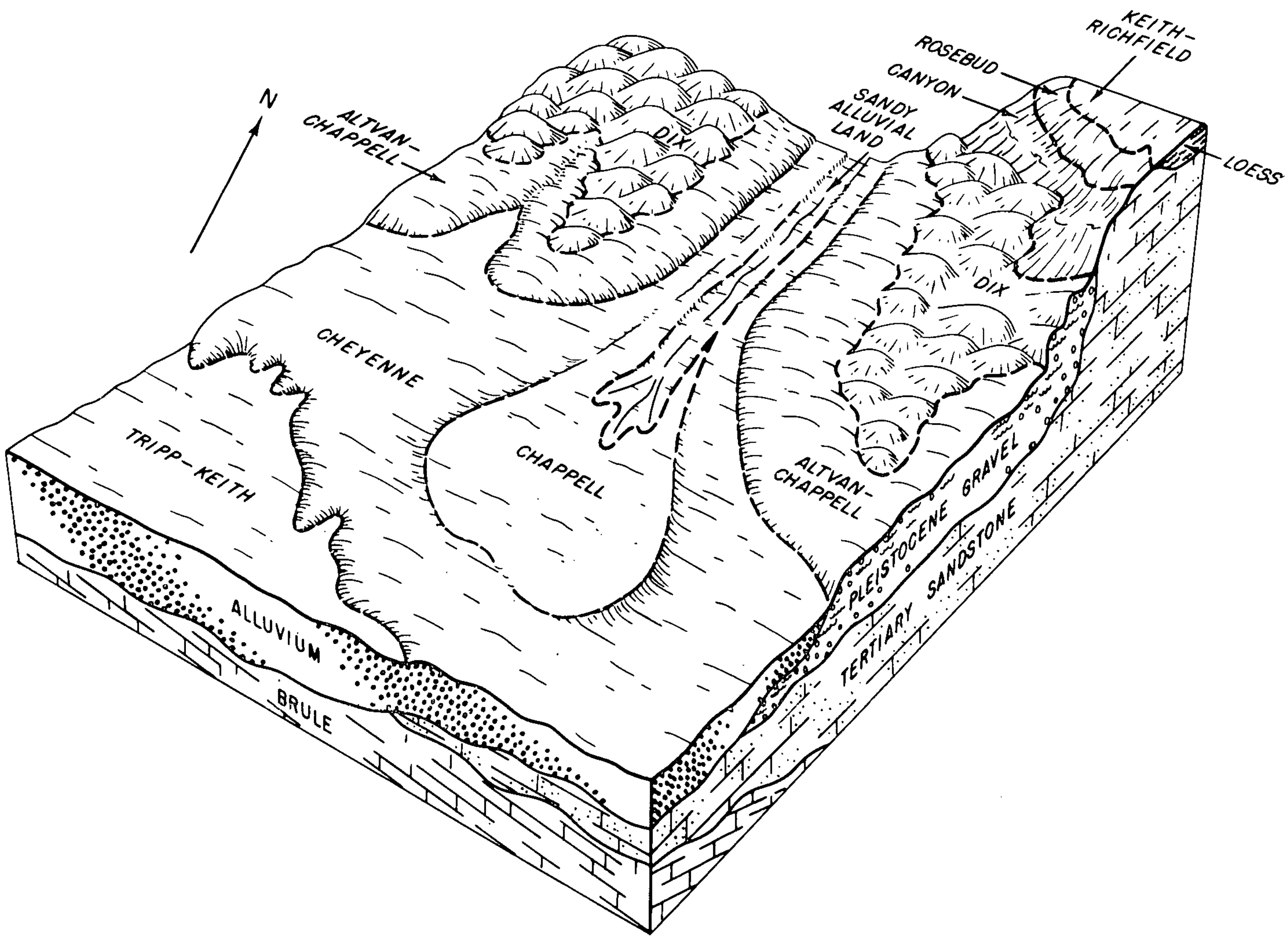

Figure 4.—**Landform and soils in the Dix-Altvan and the Cheyenne-Tripp soil associations.**

chief cultivated crop is winter wheat. Soils suitable for cultivation produce good yields of wheat under efficient management. Other important crops include winter barley, grain sorghum, and feed crops.

Figure 5.—**Beef cattle in an area of native grass, Dix-Altvan soil association.**

Water erosion is a hazard on the sloping soils of this association. Flash rainstorms and water from melting snow severely damage unprotected areas. Proper management of grazing is important on range.

3. Keith-Colby association: Rolling silty uplands

In this upland soil association gentle slopes are interspersed with strong slopes in areas where thick deposits of windblown silt have accumulated. The high, rounded ridges in the association are long and narrow and extend generally in a northwest-southeast direction.

The main soils in this association are the Keith, Colby, and Ulysses soils (fig. 6). Keith soils, the most extensive, occur on the milder slopes and are deep, dark, loamy, and fertile. Colby and Ulysses soils are deep and light colored; they occupy the ridges and other strongly sloping or steep areas that are scattered throughout the association and are the most prominent features of the landscape. The association also includes small areas of other soils.

Most of this soil association is cultivated. Native grass remains only in some of the steeper or the larger areas of Colby and Ulysses soils. Many strongly sloping areas are cultivated along with large areas of more nearly level soils.

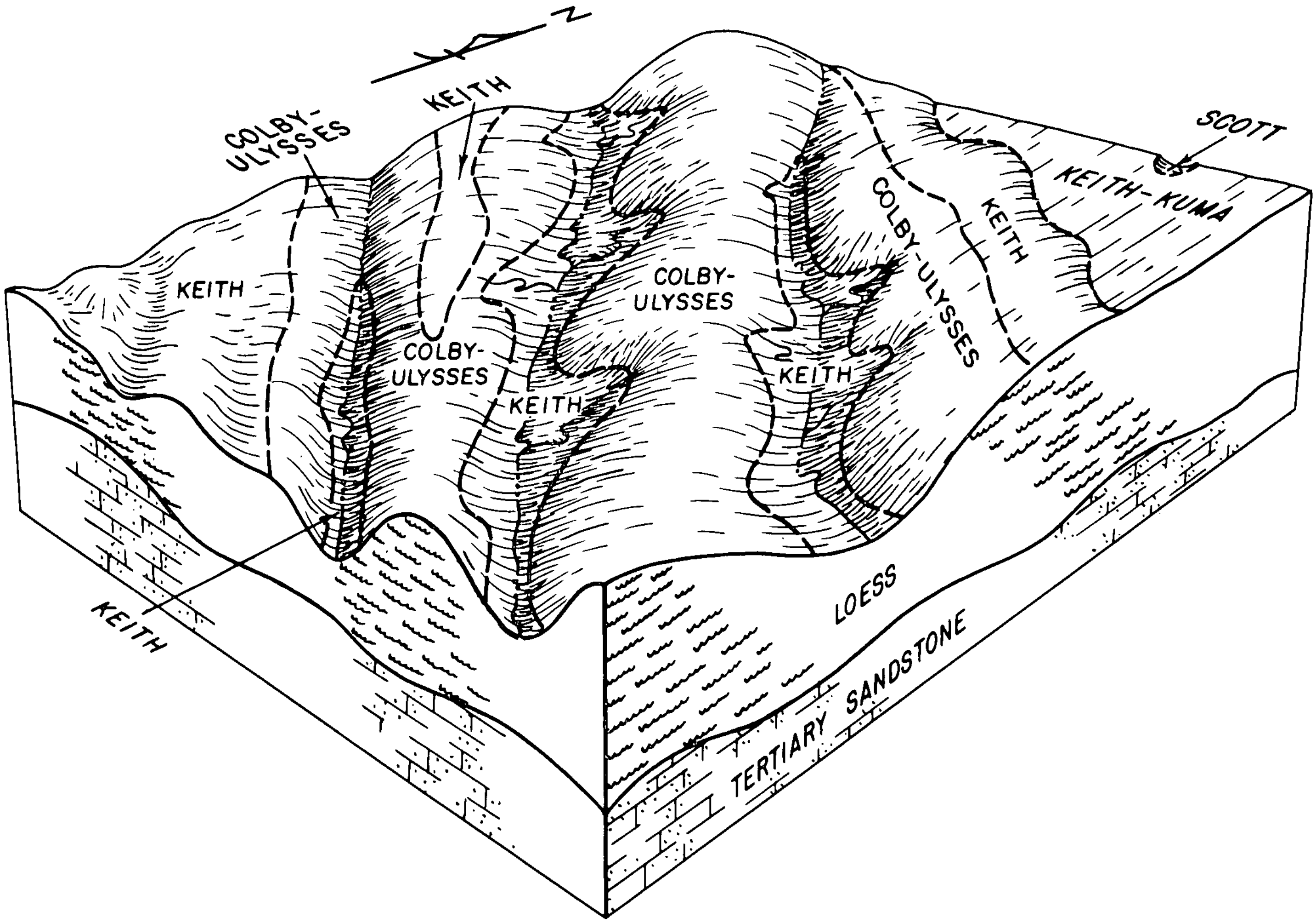

Figure 6.—**Landform and soils in the Keith-Colby soil association.**

The main crop is winter wheat. On the soils well suited to this crop, yields are high under good management. Other crops include winter barley, grain sorghum, and feed crops. The farms contain 640 acres or more, and their operations are highly mechanized.

Water erosion is a problem in the sloping areas that are not protected or are not suited to cultivation. Most of the damage is caused by flash rainstorms and melting snow. Proper use is important in managing range.

4. Las-Las Animas association: Bottom lands

This soil association consists of nearly level flood plains, or first bottoms, that are in two bands. One band, about half a mile wide, is along Lodgepole Creek (fig. 7); the other is 1½ to 2 miles wide and lies along the South Platte River. During periods of high water, these areas are flooded first.

Soils of this association formed in mixed sediments of varied texture that were recently laid down by water and have been changed little or none by soil development. Las soils are the most extensive; Wet alluvial land covers the next largest acreage; and Las Animas soils and Slickspots also are extensive (fig. 8).

Las soils are deep, dark colored, loamy, and imperfectly drained. Wet alluvial land occurs in the old bed of the South Platte River and consists of extremely stratified, light-colored, loose sand and gravel. Las Animas soils are sandy, moderately deep, and imperfectly drained. Slickspots are made up of loamy soil material that is

Figure 7.—**Bottom land along Lodgepole Creek.**

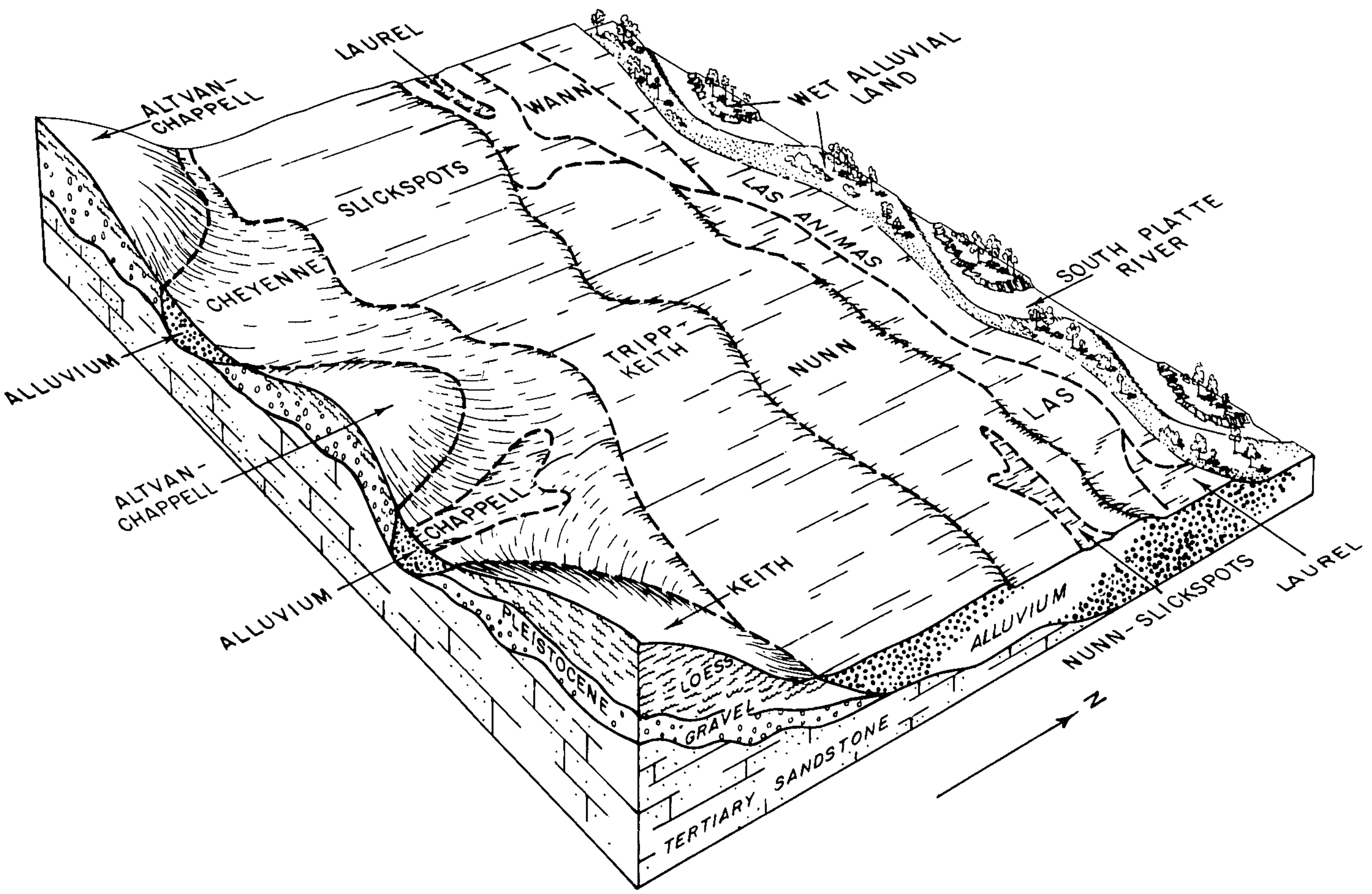

Figure 8.—**Landform and soils in the valley of the South Platte River, southeastern Deuel County.**

saline-alkali. In addition, Bayard, Laurel, and Wann soils occur in this association.

About half of the association is cultivated, and the rest is in native grass and scattered trees. The trees grow only on Wet alluvial land. The areas in grass are used for pasture or hay.

Nearly all the cultivated areas are irrigated. The main crops are corn, sugar beets, and alfalfa. Because the soils are saline and alkaline and have a high water table, yields of irrigated crops are lower in this association than on the benchlands.

Good wells for irrigation can easily be developed throughout this association. In some places, however, the soils are poorly suited to crops and to irrigation. Wind erosion is a hazard, especially on the sandy soils. Irrigating the soils carefully is important.

5. Anselmo-Keith association: Moderately sandy uplands

This soil association occupies two irregularly shaped areas in the county, one in the south-central part and the other in the northeastern. Each of these areas is about 4 miles long and 1 to 1½ miles wide. On the surface are slight hummocks or long, low, interrupted ridges.

The principal soils of this association formed in a mixture of sand and silt deposited by wind (fig. 9). Most extensive are the Anselmo, Keith, and Tripp soils, but the Goshen and Valentine soils, as well as other soils, also occur. The Anselmo soils are deep and moderately sandy; they generally occupy the ridges and stronger slopes. The Keith and Tripp soils are deep, have a fine sandy loam surface layer and a loamy subsoil, and occur on the more gentle slopes.

Goshen soils are in small areas in narrow swales and are deep and dark colored. Valentine soils lie on a few of the small ridges. They are deep and very sandy. Other soils occur in the association, but their acreage is small.

Most of this association is cultivated, mainly to winter wheat and grain sorghum. These crops are well suited to the soils and generally produce high yields under good management. Other crops grown include winter barley and corn. Some of the larger areas of sandy soils have been left in native grass or reseeded because they are difficult to manage if cultivated. Parts of large farms make up most of the association.

The severe risk of wind erosion is a problem, especially during droughts. Because the soils are sandy, they erode easily if the native plants have been removed or are sparse.

6. Cheyenne-Tripp association: Benchlands

This soil association consists of nearly flat, well-drained benches, or terraces, that occur along Lodgepole Creek and

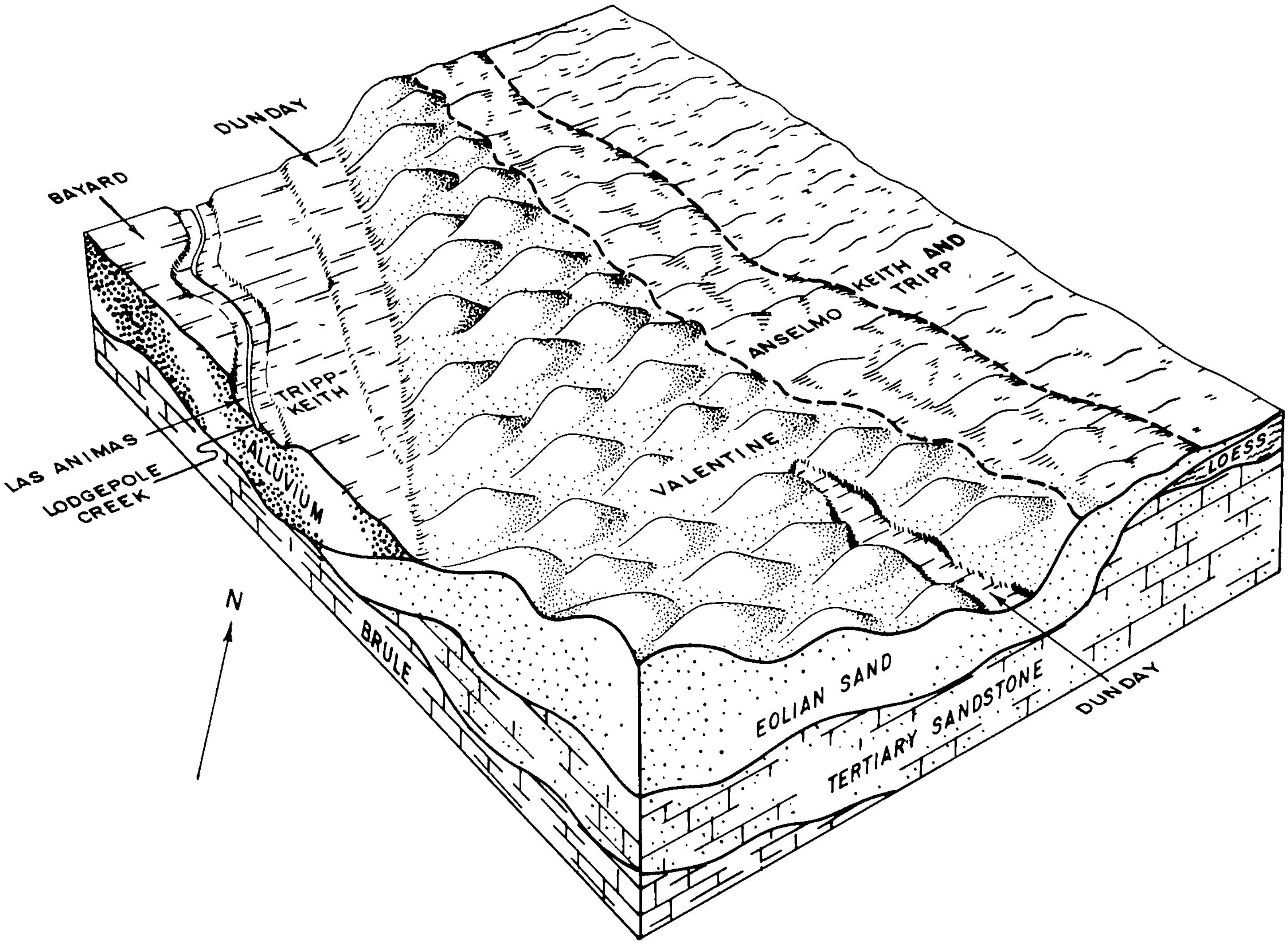

Figure 9.—**Landform and soils in the Valentine and the Anselmo-Keith soil associations in south-central Deuel County.**

the South Platte River. It includes narrow, gravelly areas along intermittent drainageways.

The major soils of this association formed in loamy and moderately sandy sediments that were laid down by water and, in a few places, were reworked by wind. The Cheyenne, Tripp, Keith, and Chappell soils are the most extensive, but the Bayard and Nunn soils also are in large areas. (See fig. 4, p. 4, and fig. 8, p. 6.)

Cheyenne and Chappell soils occupy the high benchlands and are moderately deep. The Cheyenne soils are loam, whereas the Chappell soils are sandy loam. The Tripp and Keith soils occur throughout the association and are deep, dark, and loamy. Bayard soils are deep and moderately sandy. The Nunn soil is a deep, dark silt loam that has a moderately fine textured subsoil. Sandy alluvial land occurs in small areas along the major upland drainageways; it is very sandy and gravelly.

Most of this association is well suited to cultivation. The Tripp, Keith, Cheyenne, Chappell, Bayard, and Nunn soils are the important irrigated soils in the county. Except for Sandy alluvial land, nearly all the acreage in the association is cropped, and much of it is irrigated (fig. 10). The principal irrigated crops are corn, sugar beets, and alfalfa. The main crop under dryland farming is winter wheat. Many of the irrigated farms are about 160 acres. Farm operations are highly mechanized.

Water for irrigation is easily accessible from wells in this area. Applying the water efficiently is important. Wind erosion is a hazard, mainly on the sandy soils.

7. Valentine association: Rolling sands

This soil association consists of very sandy soils that are hummocky and, in places, resemble typical Nebraska sandhills. It lies just east of Lodgepole Creek in an area that is 1 to 2 miles wide and extends 6 to 7 miles northwestward from the Colorado line.

All the soils of this association formed in sandy material deposited and shifted by wind. The Valentine soils are by far the most extensive. (See fig. 9.) These soils are deep sands that have a surface layer slightly darkened by organic matter. Also, in the association on low slopes are small areas of Dunday loamy fine sand, which is a deep, dark-colored soil.

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Figure 10.—**Irrigated benchland south of Big Springs, Nebraska, in the Cheyenne-Tripp soil association.**

This association is one of the main grazing areas in the county and is an important livestock area. Beef cattle are numerous. Nearly all of the association is grazed by brood cows throughout the year and commonly by yearlings in summer. The soils are not suited to cultivation but are well suited to native grass.

Wind erosion is a hazard in this area. If the grass cover is reduced, the soils blow severely. A few small blowouts have formed in places where the grass has been destroyed. Management of grazing is important in maintaining a cover of native plants.

Use and Management of Soils

This section consists of several parts. The first discusses the general practices of management needed on dry-farmed soils and on irrigated soils. Next there is an explanation of the capability classification of soils. The next two parts deal with the capability groups of soils for dryfarming and for irrigation. Then there is a part consisting of two tables that give estimated yields of crops, a part on the use and management of rangeland, one on woodland and windbreaks, and one on the use of soils in engineering.

General Practices of Management

In Deuel County the purposes of managing dry-farmed soils are to conserve moisture, to control wind and water erosion, and to maintain fertility. Of these, the most important is conserving moisture because the amount of rainfall in the county is small and varies widely from year to year.

Research and experience have shown that dryland crops can be grown most efficiently and most profitably by fallowing the soils for a year. During the fallow period, weeds and volunteer crops are destroyed and the soil surface is kept open and porous so that it can absorb moisture. If soils are fallowed, their moisture is retained and their fertility is built up for the next crop. In a system called black fallow, all crop residue is plowed under and the soil is exposed to damaging winds and rains and loses moisture through evaporation. If stubble-mulch tillage is used, however, the soil is tilled in such a way that plant residue is kept on the surface and protects the soil from blowing and washing (fig. 11). Stubble mulching also helps to maintain fertility, for soils lose fertility through erosion. The stubble conserves moisture by reducing runoff, by controlling evaporation, and by keeping the soil surface open so that rainfall is absorbed.

Some advantages of stubble-mulch tillage are shown by recent experiments in western Nebraska (*7*).[1] In these experiments, soils that were stubble mulched lost only 0.08 inch of moisture through runoff in 1959, whereas soils that were black fallowed lost 1.37 inches the same year. The amount of soil washed from black-fallowed fields was more than seven times that washed from stubble-mulched fields. These results, like those obtained elsewhere, show that stubble mulching protects soils from excessive runoff and keeps them from eroding.

In a fallow field to be mulched, stubble is left undisturbed through winter because it conserves moisture and reduces erosion (fig. 12). Tillage then begins in spring. In Deuel County, farmers generally stubble mulch their soils by tilling with large machinery. On soils well suited to wheat, they commonly use a one-way disk the first time over a field. Thereafter, the soils are tilled with a sweep cultivator or other subsurface implement. The type of implement most suitable for stubble mulching is determined by the amount of residue on the soil surface.

Terraces are needed to control runoff and to reduce water erosion on all sloping soils of Deuel County except sandy ones. Because rainfall in the county is light and the soils are porous, level terraces with closed ends are constructed. By holding water on the soils where it falls, the terraces increase the amount of moisture available to plants (fig. 13). They function best if used with contour tillage and stubble mulching.

Stripcropping is needed in this county to keep soils from eroding and to save moisture. Crops and fallow are arranged in alternate strips that are laid out along the contour or across the prevailing wind. The width of

Figure 11.—**Crop residue left on the surface by stubble-mulch tillage helps to prevent erosion and to conserve moisture.**

[1] Italic numbers in parentheses refer to Literature Cited, p. 94.

Figure 12.—**Wheat stubble left standing in winter catches and holds snow.**

strips is determined largely by the texture of the surface soils. Normally, contour stripcropping is needed where terraces are used, and wind stripcropping should be used on soils that do not require terracing.

Fallow, stubble-mulch tillage, terracing, and stripcropping are effective in conserving moisture, controlling erosion, and maintaining fertility on most dry-farmed soils in Deuel County. Wheat is generally alternated with fallow in the cropping system, but other crops, chiefly grain sorghum and winter barley, also are planted. Safflower, a crop grown for the oil in the seed, is gaining in importance.

Grasses and legumes are included in the cropping sequence mainly to improve tilth and increase water intake. Their use may not increase the yield of the crop that follows, but by increasing water intake and decreasing runoff, erosion is reduced.

Experiments conducted for several years indicate that a small amount of nitrogen fertilizer increases wheat yields on most noneroded soils of the silty tablelands in western Nebraska if wheat is alternated with fallow (*10*).

In Deuel County, yields of wheat were greatly increased by fertilizer applied to test plots in 1960. Most of the increase was attributed to nitrogen, but phosphate alone and potash with nitrogen and phosphate also increased yields significantly. Nitrogen brought a much better response if applied in spring rather than in fall.

The use of commercial fertilizer, especially nitrogen, is closely related to the amount of moisture available to crops. In this county, most dryland soils are fertile enough for the small supply of moisture available. In an average year, nitrogen applied to soils used for alternate wheat and fallow generally results in only a small increase in wheat yields unless the soil is moist to a depth of more than 4 feet.

The management needed on irrigated soils in Deuel County is chiefly the efficient distribution and use of irrigation water and the maintenance of fertility. Controlling erosion is a need on sloping fields. Choosing well-suited crops is important in saline-alkali areas.

Commercial fertilizer is required for high yields of crops and should be applied in amounts determined by soil tests (*12*). Nitrogen is needed on all irrigated soils in the county except those used for alfalfa. Sugar beets and alfalfa respond well to added phosphate, but the soils generally contain enough potash for irrigated crops. Some areas, especially fields recently leveled for irrigation, may be deficient in zinc, iron, and other trace elements. Trace elements should be applied in amounts indicated by tests.

Water causes severe damage to sloping, irrigated soils that are not protected. Flash storms cause sheet and gully erosion, and both soil and water are lost when irrigation water is applied. Contour-bench leveling is effective in controlling water erosion in sloping fields. Contour benches are nearly flat terraces, or steps, that are built in a series at right angles to the general slope of a field. At the outer edge of each bench is a low dike and, next to that, a short steep drop to the next bench below. Slopes of 1 to 5 percent are suitable for contour-bench leveling if the soils are deep.

In addition to harvested crops, grass used for tame pasture is well suited to the irrigated soils of Deuel County.

Capability Groups of Soils

The capability classification is a grouping of soils that shows, in a general way, how suitable the soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to management.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. Eight capability classes are in the broadest grouping and are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

Figure 13.—**A newly constructed, level terrace filled with water from a recent rain.**

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be as many as four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, stony, or saline-alkali; and *c* indicates that the chief limitation is low rainfall or some other feature of climate.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it have little or no erosion hazard but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, which are groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about the management of soils. Capability units are generally identified by numbers assigned locally, for example, IIe-1 or IIIe-3. These numbers are not consecutive in Deuel County, because not all of the capability units used in Nebraska apply to the soils in this county.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely major reclamation projects.

Dryland Capability Groupings

All the soils of Deuel County have been placed in classes, subclasses, and capability units as shown in the list that follows. Some of the soils in this list are not suitable for cultivation under dryfarming methods. Soils of classes I through IV are in varying degrees suitable for cultivation, as explained in the discussion of each capability unit and in the subsection "Capability Groups of Soils." Soils of classes V, VI, VII, and VIII are not suitable for cultivation.

Class I. Soils that have few limitations that restrict their use. No dry-farmed soil in Deuel County is in this class.

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.

- Subclass IIc. Soils that are limited for the production of crops by too little moisture.
  - Capability unit IIc-1.—Deep, silty, nearly level soils that are easily worked.
- Subclass IIe. Soils subject to moderate erosion if they are not protected.
  - Capability unit IIe-1.—Deep, silty, very gently sloping soils that are easily worked.
  - Capability unit IIe-3.—Deep, nearly level, moderately sandy soils that are easily worked, and nearly level or very gently sloping, moderately sandy soils that have a silty subsoil.
- Subclass IIw. Soils that have moderate limitations because of excess water.
  - Capability unit IIw-4.—Deep loams that are on bottom lands, are affected by a moderately high water table, and are slightly wet but easily worked.

Class III. Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

- Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.
  - Capability unit IIIe-1.—Deep, silty, undulating soils and moderately deep, nearly level or very gently sloping loams.
  - Capability unit IIIe-2.—Deep, very gently sloping loams that have a claypan.
  - Capability unit IIIe-3.—Deep, moderately sandy, nearly level to undulating soils and deep, moderately sandy, undulating soils that have a silty subsoil.
- Subclass IIIw. Soils that have severe limitations because of excess water.
  - Capability unit IIIw-2.—Deep, silty soils that are in upland depressions, have a claypan, and are occasionally ponded.
- Subclass IIIs. Soils that have severe limitations because of moisture capacity.
  - Capability unit IIIs-2.—Deep, nearly level loams that have a claypan.
  - Capability unit IIIs-5.—Moderately deep, nearly level loams.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

- Subclass IVe. Soils subject to very severe erosion if they are cultivated and not protected.
  - Capability unit IVe-1.—Deep, rolling, silty soils and moderately deep, undulating or rolling loams.
  - Capability unit IVe-3.—Deep, rolling, moderately sandy soils and moderately deep, nearly level or very gently sloping, moderately sandy soils.
  - Capability unit IVe-5.—Deep, nearly level to undulating loamy sands.
  - Capability unit IVe-9.—Deep, undulating, silty soils that are on uplands and have a thin surface layer.
- Subclass IVw. Soils that have very severe limitations for cultivation because of excess water.
  - Capability unit IVw-5.—Moderately deep, moderately wet, sandy soils that are on bottom lands and are affected by a moderately high water table.
- Subclass IVs. Soils that have very severe limitations because of low moisture capacity, salts and alkali, or other soil features.
  - Capability unit IVs-1.—Moderately saline-alkali, loamy soils of the low benchlands.

Class V. Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, wood-

land, or wildlife food and cover. No soils in Deuel County are in class V.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass VIe. Soils severely limited, chiefly by risk of erosion, if protective cover is not maintained.

Capability unit VIe-1.—Hilly, moderately deep and shallow, loamy soils.

Capability unit VIe-5.—Deep, rolling, sandy soils.

Capability unit VIe-9.—Deep, silty, rolling or hilly soils that are on uplands and have a thin surface layer.

Subclass VIs. Soils generally unsuitable for cultivation and limited for other uses by a shallow root zone or by strong concentrations of salts and alkali.

Capability unit VIs-1.—Strongly and very strongly saline-alkali soils of the bottom lands.

Capability unit VIs-4.—Shallow soils over limy sandstone.

Capability unit VIs-41.—Shallow soils over gravelly outwash.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation, and that restrict their use largely to grazing, woodland, or wildlife.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion if protective cover is not maintained.

Capability unit VIIe-5.—Steep, hummocky, deep sands.

Subclass VIIs. Soils that are very severely limited because they are shallow and have low moisture capacity.

Capability unit VIIs-3.—Very shallow, gravelly soils.

Class VIII. Soils and landforms that have limitations that preclude their use, without major reclamation, for commercial production of plants, and restrict their use to recreation, wildlife, water supply, or esthetic purposes. No soils in Deuel County are in class VIII.

Management by dryland capability units

In this subsection the capability units of dry-farmed soils in Deuel County are described, their soils are listed, and management is discussed. Table 1 gives the approximate acreage and proportionate extent of the dryland capability units in the county.

CAPABILITY UNIT IIc-1, DRYLAND

Soils in this capability unit are deep, nearly level, and medium textured (fig. 14). The soils are—

Bayard loam, 0 to 1 percent slopes.
Bridgeport and Havre loams, 0 to 1 percent slopes.
Goshen silt loam, 0 to 1 percent slopes.
Keith-Kuma silt loams, 0 to 1 percent slopes.
Keith-Richfield silt loams, 0 to 1 percent slopes.
Nunn silt loam.
Tripp-Keith silt loams, 0 to 1 percent slopes.

These soils are easily worked. They absorb water well, but a scarcity of moisture is likely to damage crops almost every year. Conserving moisture is the principal management problem. Wind erosion is a hazard, especially in dry years.

The soils of this unit are well suited to wheat and other small grain and to grain sorghum. Yields of wheat are generally high because wheat is planted on soils that have been fallowed.

A cropping system that consists of wheat alternated with fallow conserves moisture and maintains fertility. If a 3-year cropping system is used, a suitable sequence is 1

TABLE 1.—*Approximate acreage of dryland capability units and their proportionate extent of total acreage nonirrigated and of total acreage in the county*

Capability unit	Area	Extent of nonirrigated acreage [1]	Extent of total acreage in the county [2]
	Acres	*Percent*	*Percent*
IIc-1	73, 500	27. 2	26. 4
IIe-1	70, 000	25. 9	25. 1
IIe-3	5, 251	1. 9	1. 9
IIw-4	3, 167	1. 2	1. 1
IIIe-1	30, 004	11. 1	10. 8
IIIe-2	415	. 2	. 1
IIIe-3	4, 350	1. 6	1. 6
IIIw-2	2, 654	1. 0	1. 0
IIIs-2	2, 288	. 9	. 8
IIIs-5	429	. 2	. 2
IVe-1	32, 323	12. 0	11. 6
IVe-3	7, 100	2. 6	2. 6
IVe-5	1, 941	. 7	. 7
IVe-9	200	(3)	(3)
IVw-5	1, 519	. 6	. 5
IVs-1	370	. 1	. 1
VIe-1	385	. 1	. 1
VIe-5	3, 504	1. 3	1. 3
VIe-9	1, 555	. 6	. 6
VIs-1	1, 061	. 4	. 4
VIs-4	1, 162	. 4	. 4
VIs-41	17, 365	6. 4	6. 3
VIIe-5	180	(3)	(3)
VIIs-3	9, 677	3. 6	3. 5
Total	270, 400	100. 0	97. 1

[1] Total nonirrigated area is 270,400 acres.
[2] Total area of Deuel County is 278,400 acres.
[3] Less than 0.1 percent.

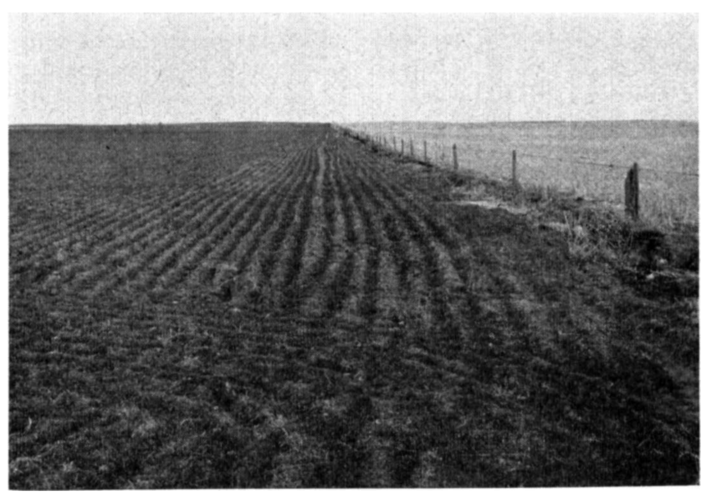

Figure 14.—Soils in capability unit IIc-1, dryland, under cultivation. Conserving moisture is the main problem of management on these soils.

year each of fallow, wheat, and other small grain or grain sorghum. Crop residue should not be burned. Wind stripcropping and stubble-mulch tillage are effective in conserving water, adding organic matter, and preventing wind erosion.

CAPABILITY UNIT IIe-1, DRYLAND

This capability unit consists of deep, medium-textured, very gently sloping soils on benchlands and uplands of the county. The soils are—

Bridgeport and Havre loams, 1 to 3 percent slopes.
Goshen silt loam, 1 to 3 percent slopes.
Keith-Richfield silt loams, 1 to 3 percent slopes.
Tripp-Keith silt loams, 1 to 3 percent slopes.

These soils are easy to cultivate, and they absorb water well. Some moisture is lost through runoff, however, and drought is likely to damage crops almost every year. Conserving moisture and controlling wind and water erosion are the main management problems.

The soils of this unit are well suited to wheat, other small grain, and grain sorghum. Wheat is the principal crop. A cropping system that consists of stubble-mulch tillage and wheat alternated with fallow helps to prevent erosion, to conserve moisture, and to maintain fertility. Also suitable is a 3-year sequence of fallow, wheat, and other small grain or grain sorghum. Terracing, stripcropping on the contour, and returning all residue to the soil are other measures needed to control erosion.

CAPABILITY UNIT IIe-3, DRYLAND

In this capability unit are deep, nearly level, moderately sandy soils that are easily worked. Also in the unit are nearly level or very gently sloping, moderately sandy soils that have a silty subsoil. The soils are—

Anselmo fine sandy loam, 0 to 1 percent slopes.
Bayard fine sandy loam, 0 to 1 percent slopes.
Goshen fine sandy loam, 0 to 3 percent slopes.
Keith and Tripp fine sandy loams, 0 to 3 percent slopes.

These soils absorb water readily and release it well, but crops are likely to be damaged nearly every year because moisture is scarce. Controlling erosion, especially wind erosion, is the principal management problem, but maintaining fertility and conserving moisture are also important.

The soils are well suited to wheat and other small grain and to grain sorghum. Fair yields of corn can be obtained some years. A rotation of wheat and fallow is suitable if stubble-mulch tillage is used. If a 3-year cropping system is used, a suitable sequence is 1 year of wheat, 1 year of fallow, and 1 year of another small grain or of grain sorghum or corn. Blowing can be controlled by stubble mulching and wind stripcropping. All plant residue should be returned to the soil.

CAPABILITY UNIT IIw-4, DRYLAND

This capability unit consists of deep loams that are on bottom lands and have a moderately high water table. The soils are—

Las loam.
Wann loam.

These soils are easy to work, but they dry and warm slowly in spring. Crops, especially those that are fairly deep rooted, obtain moisture from the ground water, though the soils often become droughty late in summer. Wind erosion is a hazard in unprotected fields.

The soils of this unit are suited to wheat, other small grain, grain sorghum, corn, and alfalfa. Yields of native grass cut for hay are good. Alternate wheat and fallow is a good cropping system if stubble-mulch tillage is used during the fallow period. In a 3-year cropping system, a suitable sequence is 1 year each of fallow, wheat, and other small grain or corn or grain sorghum. Wind erosion can be controlled by stripcropping across the direction of the prevailing wind. Return all plant residue to the soil.

CAPABILITY UNIT IIIe-1, DRYLAND

This capability unit consists of deep, undulating, silty soils and moderately deep, very gently sloping loams. These soils are slightly or moderately eroded. The soils are—

Cheyenne loam, 1 to 3 percent slopes.
Keith silt loam, 3 to 5 percent slopes.
Keith silt loam, 3 to 5 percent slopes, eroded.
Rosebud loam, 0 to 3 percent slopes.

These soils are easy to work. They absorb water well, but the more sloping areas lose some rainfall through runoff. Crops are likely to be damaged almost every year because of a scarcity of moisture. Conserving moisture and controlling wind and water erosion are the main problems of management.

Small grain and sorghum are suited to these soils, and yields of wheat are good under proper management. The management needs are about the same as for the soils in unit IIe-1, but practices should be applied with more intensity. Wheat alternated with fallow is a suitable crop if the fallowed land is stubble mulched. In a 3-year cropping system, a suitable sequence is 1 year each of fallow, wheat, and other small grain or grain sorghum. Slopes of 0 to 1 percent can be protected from damaging winds by wind stripcropping. On slopes of more than 1 percent, install terraces and stripcrop along the contour. All plant residue should be returned to the soil. The eroded Keith soil responds to additions of fertilizer.

CAPABILITY UNIT IIIe-2, DRYLAND

This capability unit consists of one complex of soils—Dawes-Keith loams, 1 to 3 percent slopes. The Dawes soils are very gently sloping soils on uplands; they are deep and have a claypan. Water is absorbed readily by the surface layer but moves slowly in the claypan subsoil. For this reason, the Dawes soils are slightly more droughty than the other medium-textured soils in this complex. Conserving moisture and controlling erosion by wind and water are the main problems of management.

Wheat and other small grain are suited to these soils. Because small grain grows and matures in spring when rainfall is highest, yields of small grain are normally higher than those of grain sorghum and other crops grown in summer.

Wheat alternated with fallow is suitable if stubble-mulch tillage is used during the fallow period. Terracing and contour stripcropping are effective in reducing runoff and controlling water erosion. All crop residue should be returned to the soil.

CAPABILITY UNIT IIIe-3, DRYLAND

This capability unit consists of deep, moderately sandy, very gently sloping or undulating soils on uplands. These

soils are slightly or moderately eroded, and some of them have a silty subsoil. The soils are—

Anselmo fine sandy loam, 1 to 5 percent slopes.
Keith and Tripp fine sandy loams, 3 to 5 percent slopes.
Keith and Tripp fine sandy loams, 3 to 5 percent slopes, eroded.
Rosebud fine sandy loam, 3 to 5 percent slopes.
Rosebud fine sandy loam, 3 to 5 percent slopes, eroded.

These soils absorb water well and release it readily to plants. Crops are likely to be damaged nearly every year because of a scarcity of moisture. Controlling wind and water erosion is the principal problem of management, but maintaining fertility and conserving moisture are also important.

The soils of this unit are suited to wheat and other small grain and to grain sorghum. Small grain is generally a dependable crop because it grows and matures in spring when rainfall is highest. Yields of corn are fair in some years, but fields planted to corn are more susceptible to erosion.

Wheat alternated with fallow is suitable if the soils are stubble mulched during the fallow period. Terracing, cover cropping, and contour stripcropping are needed to control blowing and washing. Crop residue should be returned to the soil.

CAPABILITY UNIT IIIw-2, DRYLAND

The only soil in this capability unit—Scott silty clay loam—occurs in upland depressions. It receives additional moisture as runoff from adjacent slopes. Water ponds on the surface for short periods in spring, but after it seeps away or evaporates, the soil is droughty and susceptible to blowing. Preventing wind erosion and controlling runoff from higher soils are the main problems of management.

Crops suited to this soil are sorghum for either grain or forage and other feed and grain crops grown in summer. Wheat can seldom be grown successfully because soil moisture is excessive in spring.

Most areas of this soil are small and should be managed the same way as are the fields in which they occur. A suitable cropping system consists of sorghum, millet, or other feed crops grown in summer year after year. Stubble-mulch tillage controls wind erosion and improves tilth. Terraces are needed on the slopes above the depressions to keep water from ponding.

CAPABILITY UNIT IIIs-2, DRYLAND

In this capability unit is one complex of soils—Dawes-Keith loams, 0 to 1 percent slopes. These deep, nearly level soils occur on uplands and have a claypan. Surface drainage and the movement of water through the soil are slow. Because the clay subsoil releases moisture slowly, less moisture is available to plants than from other soils of the county that have a medium-textured subsoil. Controlling wind erosion and conserving moisture are the principal problems of management.

Wheat and other small grain are suited to these soils. Because small grain grows and matures in spring when rainfall is highest, yields of small grain are generally higher than those of grain sorghum and other crops grown in summer. Wheat alternated with fallow is suitable if stubble-mulch tillage is practiced during the fallow period. Another suitable sequence is 1 year each of fallow, wheat, and other small grain or grain sorghum. Wind erosion can be controlled by wind stripcropping. Return all crop residue to the soil.

CAPABILITY UNIT IIIs-5, DRYLAND

The only soil in this capability unit is Cheyenne loam, 0 to 1 percent slopes. This nearly level soil is moderately deep and is easy to cultivate. It absorbs water well and releases it readily to plants, but the available moisture capacity is somewhat limited because the soil is only moderately deep. Consequently, crops are likely to be damaged nearly every year because they do not receive enough moisture. Conserving water is the main problem of management. Wind erosion is a hazard, especially in dry years.

Small grain and sorghum are suited to this soil. Good yields of wheat can be expected under proper management. The mangement needed is about the same as that for the soils in unit IIc-1, but crop yields are generally lower. Wheat alternated with fallow is suitable if the fields are stubble mulched during the fallow period. Also suitable is a 3-year sequence of fallow, wheat, and other small grain or grain sorghum. Use wind stripcropping, and return all plant residue to the soil.

CAPABILITY UNIT IVe-1, DRYLAND

This capability unit consists of deep or moderately deep, silty or loamy soils on uplands that are undulating or rolling. Erosion is slight or moderate. The soils are—

Altvan loam, 3 to 5 percent slopes.
Altvan loam, 3 to 5 percent slopes, eroded.
Altvan-Chappell complex, 5 to 9 percent slopes.
Altvan-Chappell complex, 5 to 9 percent slopes, eroded.
Keith silt loam, 5 to 9 percent slopes.
Keith silt loam, 5 to 9 percent slopes, eroded.
Rosebud loam, 3 to 5 percent slopes.
Rosebud loam, 3 to 5 percent slopes, eroded.
Rosebud-Canyon complex, 5 to 9 percent slopes.
Rosebud-Canyon complex, 5 to 9 percent slopes, eroded.

These soils absorb water readily but lose a large amount of rainfall through runoff. Crops are likely to be damaged every year because there is not enough moisture. Conserving moisture and controlling both wind and water erosion are the principal management problems.

The soils of this unit are not well suited to cultivated crops but can be used for small grain. Under good management, yields of wheat are fair. The best crop, however, is grass because it protects the soil most from damaging runoff. A suitable cropping system is wheat alternated with fallow or 1 year each of fallow, wheat, and grain sorghum. Another small grain can be substituted for the wheat or the grain sorghum, and the cropping system should include an occasional stand of grass. Terraces, contour stripcropping, and stubble-mulch tillage are helpful in preventing runoff, controlling erosion, improving tilth, and maintaining fertility. Burning crop residue destroys organic matter.

CAPABILITY UNIT IVe-3, DRYLAND

This capability unit consists of deep, rolling, moderately sandy soils on uplands and moderately deep, nearly level or very gently sloping, moderately sandy soils on

benchlands. These soils are slightly or moderately eroded. The soils are—

Anselmo fine sandy loam, 5 to 9 percent slopes.
Chappell sandy loam, 0 to 3 percent slopes.
Keith and Tripp fine sandy loams, 5 to 9 percent slopes, eroded.
Rosebud fine sandy loam, 5 to 9 percent slopes.
Rosebud fine sandy loam, 5 to 9 percent slopes, eroded.

These soils absorb water well and release it readily to plants, but the more sloping areas lose a large amount of water through runoff. Crops are damaged every year because there is not enough moisture. Conserving moisture and controlling wind and water erosion are the principal management problems, but maintaining fertility also is important.

Small grain and sorghum are suited to the soils of this unit. Under good management, fair yields can be obtained most years. These soils, however, are highly erodible and can be best protected from runoff and damaging winds if they are kept in grass or other close-growing crops.

The same kinds of practices are needed as for the soils in unit IIIe-3, but management should be more intense. Practices include stripcropping on the contour, using terraces and stubble-mulch tillage, and returning all crop residue to the soil. A suitable cropping system consists of wheat alternated with fallow or of fallow, wheat, and grain sorghum, in rotation. Another small grain can be substituted for wheat or sorghum in the cropping system.

CAPABILITY UNIT IVe-5, DRYLAND

Soils in this capability unit are deep, sandy, and nearly level to undulating. The soils are—

Anselmo loamy fine sand, 0 to 5 percent slopes.
Dunday loamy fine sand.

Except during high-intensity storms, these soils absorb most of the water that falls on them. Although the soils release moisture readily to plants, they hold little available water and are droughty. Protecting them from damaging winds is the principal management problem, but also important are controlling water erosion, conserving moisture, and maintaining fertility.

Wheat, barley, rye, and grain sorghum are suited to these soils, but their yields are generally low. Grass and other close-growing crops are best suited because they keep the soil from blowing.

Wind erosion can be reduced by using a cropping system that keeps the soil covered with crops, grass, or residue. If fields are stubble mulched during the fallow period, a suitable cropping sequence is 1 year each of fallow, wheat or rye, and grain sorghum, followed by grass. All residue should be returned to the soil. Use wind stripcropping in nearly level areas and on complex slopes of more than 1 percent. Contour stripcropping helps to control erosion on single slopes greater than 1 percent.

CAPABILITY UNIT IVe-9, DRYLAND

This capability unit consists of one complex of soils—Colby-Ulysses silt loams, 3 to 5 percent slopes. These undulating soils are on uplands, have a thin surface layer, and are deep, silty, and limy. Where cultivated, they are moderately eroded.

These soils absorb water well but lose a large amount through runoff. Crops are likely to be damaged each year because moisture is scarce. The chief management problems are conserving moisture and controlling water and wind erosion.

Fair yields of wheat can be obtained under good management, and the soils are also suited to other small grain and to sorghum. Their best use, however, is grass because it is most effective in reducing runoff and controlling erosion.

The management needed includes terracing, contour stripcropping, stubble mulching, and returning all residue to the soil. A suitable cropping system is wheat alternated with fallow or 1 year each of fallow, wheat, and grain sorghum. Another small grain can be substituted for wheat or for sorghum in the sequence. The cropping system should include an occasional stand of grass.

CAPABILITY UNIT IVw-5, DRYLAND

This capability unit consists of moderately deep, sandy soils that occur on bottom lands and have a moderately high water table. The soils are—

Las Animas fine sandy loam.
Las Animas loamy sand.

Although water is excessive because the water table is moderately high, these soils are droughty at times. A cover of growing plants is difficult to establish because the surface layer is sandy, droughty, and susceptible to wind erosion. Preventing wind erosion is the main management problem, but conserving moisture and maintaining fertility are also important.

Crops suited to these soils are wheat, other small grain, sorghum for grain, corn, and alfalfa. Best suited are grass and other close-growing crops, for they provide the most protection from damaging winds. Because deep-rooted plants cut for hay obtain moisture from the high ground water, fair yields of these crops can be expected.

A suitable cropping system consists of (1) alternate wheat and fallow, or (2) a sequence of fallow, wheat, and sorghum, or (3) a sequence of fallow, small grain, sorghum, and grass. Soil blowing can be controlled by using stubble-mulch tillage, stripcropping across the direction of the prevailing wind, and returning all residue to the soil.

CAPABILITY UNIT IVs-1, DRYLAND

Only Nunn-Slickspots complex is in this capability unit. This complex consists of loamy, moderately saline-alkali soils of the low benchlands. They have poor structure caused by salts and alkali and, consequently, are droughty. Tilth is poor, permeability is moderate or slow, and the salts are toxic to plants. Reclaiming the soils is generally costly.

These soils are best suited to wheatgrass and other crops that tolerate salts and alkali. Crop yields are low under dryland farming but are fair under irrigation.

The management most suitable for these soils consists of growing salt- and alkali-tolerant crops rather than using chemical amendments. Erosion can be controlled, moisture conserved, and fertility maintained by summer fallowing, stubble mulching, wind stripcropping, and returning all residue to the soil. Barnyard manure applied to the soil and grass used in the cropping system aid in improving tilth, structure, and permeability.

CAPABILITY UNIT VIe-1, DRYLAND

This capability unit consists only of Rosebud-Canyon complex, 9 to 15 percent slopes. The soils of this complex are loamy and moderately deep or shallow. They occur on hilly slopes where runoff is rapid and the risk of water erosion is severe. These soils are not suited to cultivated crops. They are best suited to native grass used for grazing. Areas now in cultivation should be seeded to grass.

These soils are in the Shallow Limy range site. Their management is discussed in the subsection "Use and Management of Rangeland."

CAPABILITY UNIT VIe-5, DRYLAND

This capability unit consists of deep, rolling, sandy soils. They are—

Anselmo loamy fine sand, 5 to 9 percent slopes.
Valentine fine sand, rolling.

These soils are too sandy and droughty and too erodible for cultivation. They are best suited to grass used for grazing. Areas now cultivated should be seeded to native grass.

These soils are in the Sands range site. Their management is discussed in the subsection "Use and Management of Rangeland."

CAPABILITY UNIT VIe-9, DRYLAND

Only Colby-Ulysses silt loams, 5 to 15 percent slopes, are in this capability unit. These rolling or hilly soils occur on uplands and are deep, silty, and limy. Cultivated areas are eroded. Because runoff is rapid, the soils are highly susceptible to water erosion if unprotected. They are not suitable for continuous cultivation. They are best suited to grass used for grazing.

This complex of soils is in the Thin Silty range site. Its management is discussed in the subsection "Use and Management of Rangeland.

CAPABILITY UNIT VIs-1, DRYLAND

This capability unit consists of strongly and very strongly saline-alkali soils of the bottom lands. They are—

Laurel soils.
Slickspots.

These soils are generally unsuitable for cultivation, though some areas can be used for irrigated crops if management is good. They are best suited to salt- and alkali-tolerant grasses used for grazing or hay.

The soils of this unit are in the Saline Subirrigated range site. Their management is discussed in the subsection "Use and Management of Rangeland."

CAPABILITY UNIT VIs-4, DRYLAND

This capability unit consists of one complex of soils, Canyon complex. These soils are shallow and are underlain by limy sandstone. They commonly occur on knobs or knolls surrounded by more productive soils. They are too shallow for cultivation and, where possible, should be kept under a cover of grass used for grazing. Small areas in cultivated fields cannot be pastured or profitably cropped and must remain idle.

The soils of this unit are in the Shallow Limy range site. Their management is discussed in the section "Use and Management of Rangeland."

CAPABILITY UNIT VIs-41, DRYLAND

This capability unit consists of shallow soils underlain by gravelly outwash. They are—

Dix complex, 5 to 20 percent slopes.
Dix-Chappell loams, 9 to 15 percent slopes.
Sandy alluvial land.

These soils occur on the bottoms and the slopes along the South Platte River, Lodgepole Creek, and the tributaries of these streams. They are also on knobs within cultivated fields. The soils are too shallow for cultivation and are best suited to grass used for grazing.

The soils in this unit are in the Shallow to Gravel range site. Their management is discussed in the subsection "Use and Management of Rangeland."

CAPABILITY UNIT VIIe-5, DRYLAND

The only soil in this capability unit is Valentine fine sand, hilly. This soil is deep and hummocky. It is too steep, too droughty, and too erodible for cultivation and is best suited to a permanent cover of plants used for grazing.

This soil is in the Choppy Sands range site. Its management is discussed in the subsection "Use and Management of Rangeland."

CAPABILITY UNIT VIIs-3, DRYLAND

This capability unit consists of very shallow, gravelly soils that occur along streams and on uplands. The soils are—

Dix complex, 20 to 30 percent slopes.
Wet alluvial land.

These soils are too shallow and too gravelly for cultivation and are suited only to permanent vegetation. They are in the Very Shallow Porous range site, though about 20 percent of Wet alluvial land is under grasses like those listed for the Subirrigated range site. Their management is discussed in the subsection "Use and Management of Rangeland."

Irrigated Capability Groupings

Shown in the following list are the soils of Deuel County considered suitable for irrigation. Soils that would be in classes V, VII, and VIII if irrigated are not included in this list, because irrigation of the soils in these classes is not considered feasible. Soils in class VI if irrigated are generally not suitable for irrigation, and most of them are not listed, but one capability unit in class VI is described because some areas of soils in that unit are being irrigated.

Class I. Soils that have few limitations that restrict their use.
- Capability unit I-1.—Deep, nearly level, silty soils that are on benchlands and bottom lands and are easily worked.

Class II. Soils that have some limitations that reduce the choice of plants or require moderate conservation practices.
- Subclass IIe. Soils subject to moderate erosion if they are not protected.
  - Capability unit IIe-1.—Very gently sloping, deep and moderately deep, silty soils on benchlands that are easily worked.

Capability unit IIe-3.—Moderately sandy, deep, nearly level soils on benchlands.

Subclass IIw. Soils that have moderate limitations because of excess water.

Capability unit IIw-4.—Deep, loamy, slightly wet soils that are on bottom lands and have a moderately high water table but are easily worked.

Subclass IIs. Soils that have moderate limitations because of moisture capacity.

Capability unit IIs-5.—Moderately deep, nearly level loams.

Class III. Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

Subclass IIIe. Soils subject to severe erosion if they are cultivated and not protected.

Capability unit IIIe-3.—Moderately sandy, moderately deep, nearly level or very gently sloping soils on benchlands and bottom lands.

Subclass IIIw. Moderately wet soils on nearly level bottom lands.

Capability unit IIIw-6.—Slightly sandy, moderately deep, nearly level soils that occur on bottom lands and have a fairly high water table.

Subclass IIIs. Soils that have severe limitations because of moisture capacity and salts and alkali.

Capability unit IIIs-1.—Moderately saline-alkali, loamy soils of the low benchlands.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVw. Soils that have very severe limitations to cultivation because of excess water.

Capability unit IVw-5.—Moderately deep loamy sands that occur on bottom lands and are affected by a moderately high water table.

Subclass IVs. Soils that have very severe limitations because of salts and alkali.

Capability unit IVs-1.—Strongly saline-alkali soils of the bottom lands.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or range, woodland, or wildlife food and cover.

Subclass VI. Soils severely limited by strong concentrations of salt and alkali.

Capability unit VIs-1.—Very strongly saline-alkali soils that occur on bottom lands and can be cultivated only under the best management.

Management by irrigated capability units

In this subsection the soils of Deuel County that are suitable for irrigation are placed in capability units, and use and management are discussed for each unit. Table 2 lists the approximate acreage and proportionate extent of the irrigated capability units in the county.

TABLE 2.—*Approximate acreage of irrigated capability units and their proportionate extent of total acreage irrigated and of total acreage in the county*

Capability unit	Area	Extent of irrigated acreage[1]	Extent of total area of the county[2]
	Acres	*Percent*	*Percent*
I-1	2,953	36.9	1.0
IIe-1	1,552	19.4	.6
IIe-3	843	10.5	.3
IIw-4	900	11.3	.3
IIs-5	550	6.9	.2
IIIe-3	398	5.0	.2
IIIw-6	210	2.6	.1
IIIs-1	300	3.8	.1
IVw-5	90	1.1	(3)
IVs-1	124	1.5	.1
VIs-1	80	1.0	(3)
Total	8,000	100.0	2.9

[1] Total irrigated area is 8,000 acres.
[2] Total area of Deuel County is 278,400 acres.
[3] Less than 0.1 percent.

CAPABILITY UNIT I-1, IRRIGATED

This capability unit consists of deep, nearly level loams and silt loams on benchlands and bottom lands. The soils are—

Bayard loam, 0 to 1 percent slopes.
Bridgeport and Havre loams, 0 to 1 percent slopes.
Nunn silt loam.
Tripp-Keith silt loams, 0 to 1 percent slopes.

These soils are easy to work. They absorb water well, release it readily to plants, and have a high available water capacity. The main management needs are maintaining fertility and properly using irrigation water. Unless the surface is protected, wind erosion is a hazard.

Crops suited to these soils are corn, sugar beets, alfalfa, potatoes, dry beans, sorghum, small grain, and grass. The chief crops grown are corn, alfalfa, and sugar beets.

Fertility can be maintained by rotating crops and by adding fertilizer as indicated by soil tests. Rotating crops aids in the control of insects and plant diseases. Fertility and tilth are improved by using a cropping system that includes a legume or a grass-legume mixture. If a cultivated crop is harvested so late that a winter grain crop cannot be planted the same year, wind erosion can be controlled through winter by roughening the soil surface.

CAPABILITY UNIT IIe-1, IRRIGATED

This capability unit consists of very gently sloping, deep and moderately deep, loamy soils of the benchlands. The soils are—

Bridgeport and Havre loams, 1 to 3 percent slopes.
Cheyenne loam, 1 to 3 percent slopes.
Tripp-Keith silt loams, 1 to 3 percent slopes.

These soils are easily worked. They absorb water well and release it readily to plants; their available water capacity is high. The main needs of management are properly using irrigation water, maintaining fertility, and controlling erosion.

Crops suited to these soils are corn, sugar beets, alfalfa, potatoes, dry beans, sorghum, small grain, and grass. The main crops grown are corn, alfalfa, and sugar beets.

Fertility can be maintained by using fertilizer in amounts determined by soil tests. Crop rotations are needed to aid in controlling insects and plant diseases and in keeping fertility high. Legumes or grass-legume mix-

tures in the cropping system help to maintain soil fertility and tilth. If a cultivated crop is harvested so late that the following crop cannot be seeded in fall, the soil surface should be roughened to control wind erosion through winter.

CAPABILITY UNIT IIe-3, IRRIGATED

The only soil in this capability unit is Bayard fine sandy loam, 0 to 1 percent slopes. This deep, nearly level, moderately sandy soil is on the benchlands. The soil absorbs water well and releases it readily to plants but is low in available water capacity. The chief problems of management are applying irrigation water properly, maintaining fertility, and controlling wind erosion.

Crops suited to this soil are corn, sugar beets, alfalfa, potatoes, dry beans, sorghum, small grain, and grass. The main crops grown are corn, alfalfa, and sugar beets.

This soil should be tested periodically, and fertilizer applied as needed. Rotating crops aids in the control of insects and plant diseases and helps maintain fertility. Soil tilth and fertility are improved by using legumes or grass-legume mixtures in the cropping system. If needed to control blowing, plant a cover crop or roughen the soil surface.

CAPABILITY UNIT IIw-4, IRRIGATED

This capability unit consists of deep, loamy soils on bottom lands that are slightly wet because the water table is moderately high. In some places these soils contain a moderate amount of salts or alkali. The soils are—

Las loam.
Wann loam.

These soils are easily worked. Although their permeability is variable, they absorb and release water fairly well, and their available water capacity is moderately high. Properly using irrigation water and maintaining fertility are the main management problems. Unless the surface is protected, wind erosion is a hazard.

The crops suited to these soils are corn, sugar beets, alfalfa, potatoes, dry beans, sorghum, small grains, and grass. The main crops are corn, alfalfa, and sugar beets.

Fertilizer can be used to maintain fertility and should be applied in amounts determined by soil tests. A suitable crop rotation is needed to help maintain fertility and control insect pests and plant diseases. Soil tilth and fertility are improved by using legumes or grass-legume mixtures in the cropping system. If a crop is harvested so late in the year that the next crop cannot be planted until spring, wind erosion in winter can be controlled by roughening the soil surface.

In irrigating the soils of this unit, the management needed is about the same as for the soil in unit IIs-5. On these soils, however, crops generally obtain moisture from the ground water and, consequently, require irrigation slightly less often or in smaller amounts. Some areas need draining.

CAPABILITY UNIT IIs-5, IRRIGATED

Cheyenne loam, 0 to 1 percent slopes—the only soil in this capability unit—is moderately deep. The soil absorbs water well and releases it readily to crops, but the available water capacity is only moderate. Properly using irrigation water and maintaining fertility are the main needs of management. Where the surface is not protected, there is a risk of wind erosion.

The crops suited to this soil are corn, sugar beets, alfalfa, potatoes, dry beans, sorghum, small grain, and grass. The main crops are corn, alfalfa, and sugar beets.

Fertilizer can be used to maintain fertility and should be applied in amounts determined by soil tests. Rotating crops helps to control insect pests and plant diseases and to maintain fertility. By using legumes or grass-legume mixtures in the cropping system, soil tilth and fertility are improved. If a crop is harvested so late in the season that the next crop cannot be planted until spring, soil blowing in winter can be controlled by roughening the surface.

CAPABILITY UNIT IIIe-3, IRRIGATED

The only soil in this capability unit is Chappell sandy loam, 0 to 3 percent slopes. This soil occupies benchlands. It is moderately sandy, moderately deep, and nearly level or very gently sloping.

This soil absorbs water well and releases it readily to plants, but its available water capacity is low because the soil is sandy and only moderately deep. The chief problems are controlling erosion, maintaining fertility, and using irrigation water properly.

Crops suited to the soil of this unit are corn, sugar beets, alfalfa, potatoes, dry beans, sorghum, small grain, and grass. The main crops are corn, alfalfa, and sugar beets.

Fertilizer is needed to keep this soil fertile. Soil tests will indicate the amounts to apply. Rotating crops helps to maintain fertility and to control insects and plant diseases. By including legumes or grass-legume mixtures in the cropping system, fertility and tilth can be improved. Where needed to control wind erosion, roughen the soil surface or plant a cover crop.

CAPABILITY UNIT IIIw-6, IRRIGATED

Las Animas fine sandy loam is the only soil in this capability unit. It is a nearly level, moderately deep, slightly sandy soil that occurs on bottom lands and is moderately wet because the water table is fairly high. The soil absorbs water well and releases it readily to plants, but its available water capability is low because the soil is sandy and only moderately deep. The chief problems are maintaining fertility, controlling erosion, and properly using irrigation water.

Crops suited to this soil are corn, sugar beets, alfalfa, potatoes, dry beans, sorghum, small grain, and grass. The main crops grown are corn, alfalfa, and sugar beets.

To maintain fertility, apply fertilizer in amounts indicated by soil tests. Rotate crops to help in controlling insects and plant diseases and in maintaining fertility. Legumes or legume-grass mixtures included in the cropping system improve fertility and tilth. Where needed to control wind erosion, roughen the soil surface and plant a cover crop.

CAPABILITY UNIT IIIs-1, IRRIGATED

This capability unit consists only of Nunn-Slickspots complex. These are moderately saline-alkali, loamy soils that occupy the low benchlands. They take in water slowly and release it slowly to plants, but their available water capacity is high. The main problems consist of

choosing the right crops to grow, properly using irrigation water, and maintaining fertility.

Among the crops suited to these soils, sugar beets, barley, and tall wheatgrass are highly tolerant of salts and alkali. Alfalfa, wheat, sorghum, and corn are crops moderately tolerant. Under good management, high yields can be obtained from sugar beets, alfalfa, tall wheatgrass, and corn.

Applications of fertilizer are needed to keep these soils fertile. Alfalfa, sugar beets, and other crops generally respond well to additions of phosphate and nitrogen. Soil tests will indicate the amounts to apply. Rotating crops helps to maintain fertility and to control insects and plant diseases. If a crop is harvested so late in the year that the next crop cannot be planted until spring, wind erosion in winter can be controlled by roughening the soil surface. Fertility, tilth, and permeability are improved by using manure and including legumes or grass-legume mixtures in the cropping system.

Because the soils of this unit are droughty, they must be irrigated frequently. They are slowly permeable, however, and cannot absorb much water rapidly. They should be irrigated at a rate about the same as that for clayey soils. In other respects, their irrigation requirements are like those of soils in unit I–1. Farmers and others familiar with these soils can give more information about the soils.

CAPABILITY UNIT IVw–5, IRRIGATED

The only soil in this capability unit is Las Animas loamy sand. It is a moderately deep soil that occurs on bottom lands and is affected by a moderately high water table. Although water is absorbed and released readily, this soil is so sandy that little moisture is held for plants. The main problems of management are controlling wind erosion, maintaining fertility, and using irrigation water properly.

Crops suited to this soil are corn, sugar beets, alfalfa, potatoes, dry beans, sorghum, small grain, and grass. The main crops grown are corn, alfalfa, and sugar beets.

Fertilizer can be used to maintain fertility and should be applied in amounts determined by soil tests. Rotating crops aids in the control of insects and plant diseases and helps maintain fertility. By using legumes of grass-legume mixtures in the cropping system, tilth and fertility are improved and blowing is reduced. Other practices that help to control wind erosion are cover cropping and surface roughening.

CAPABILITY UNIT IVs–1, IRRIGATED

This capability unit consists of strongly saline-alkali soil materials that occur on bottom lands and are called Slickspots. These materials absorb and release water slowly. Because the salts and alkali are toxic to crops, selecting the right crops to plant is a problem of management. Maintaining fertility and properly using irrigation water are other problems.

Sugar beets, barley, and tall wheatgrass are suited to Slickspots and highly tolerant of salts and alkali. Fair yields can be obtained from sugar beets and from alfalfa, a fairly tolerant crop. Yields of corn are poor. Best suited is grass or a mixture of grass and alfalfa. Good yields can be expected from alfalfa mixed with tall wheatgrass.

Fertilizer helps to keep Slickspots fertile if it is applied in amounts indicated by soil tests. Alfalfa and sugar beets respond well to additions of phosphate. If possible, crops should be rotated to help in controlling insects and plant diseases. Apply manure and use legumes or grass-legume mixtures in the cropping system to improve fertility, tilth, and permeability. In fields where crops are harvested so late that the next crop cannot be planted until spring, roughen the surface to control wind erosion in winter.

The soil materials in this capability unit are droughty because the movement of water through them is slow. They should be irrigated in about the same way as are clayey soils. Frequent, light applications of water are best. Otherwise, the irrigation needs are similar to those of soils in unit I–1. Farmers and others who are familiar with Slickspots can provide more information about their management.

CAPABILITY UNIT VIs–1, IRRIGATED

The only soils in this capability unit—Laurel soils—are on bottom lands and are very strongly saline-alkali. They take in water slowly and release it slowly to plants. Most crops cannot be grown successfully on these soils, because the salts and alkali are toxic.

Laurel soils are generally unsuitable for cultivation, though some areas are cultivated. Under the best management practical, only a few different kinds of crops can be grown. Best suited are salt- and alkali-tolerant grasses and legumes. Fair yields can be obtained from tall wheatgrass grown alone or in mixture with alfalfa. Yields of sugar beets are low.

Fertilizer helps to keep cultivated areas fertile if it is applied according to needs indicated by soil tests. Because the concentration of alkali is strong, phosphorus is not available in large amounts and should be added. Apply manure to help improve tilth and to increase permeability and fertility. Use a cropping system that consists of grass or a grass-legume mixture grown continuously.

Laurel soils are slowly permeable and are droughty. In proper irrigation, applications of water are light and frequent. Apply water at a rate about the same as that for clayey soils. In other respects, the irrigation needs are similar to those of soils in unit I–1. Additional information can be obtained from farmers and other persons experienced in irrigating these soils.

Predictions of Yields

In this subsection are predictions of yields for the soils that are suitable for dryland farming and for the soils that are suitable for irrigation farming. The estimates are based on yield records published by the Nebraska Department of Agriculture and Inspection (*11*) and on information obtained from farmers, soil conservation district supervisors, the county agricultural agent, the Soil Conservation Service, and the county Agricultural Stabilization and Conservation committee.

Table 3 gives the predicted average acre yields of principal dryland crops grown in Deuel County under two levels of management. Table 4 lists the predicted average acre yields of the main irrigated crops grown in the county under two levels of management. These pre-

TABLE 3.—*Predicted average acre yields of principal crops grown on dry-farmed soils under two levels of management*

[Yields in columns A are those obtained under common management; those in columns B are yields to be expected under high-level management. Presence of yield does not necessarily mean that crop is grown on soil, but dashed lines indicate that crop is not grown on soil]

Map symbol	Soil	Wheat		Grain sorghum		Winter barley		Oats		Safflower		Corn		Forage sorghum		Wild hay	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
		Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Lbs.*	*Lbs.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
3AB	Altvan loam, 3 to 5 percent slopes	13	18	14	19	11	16	12	18	550	750	8	12	0.6	1.0	----	----
3AB2	Altvan loam, 3 to 5 percent slopes, eroded	10	15	11	16	9	14	9	15	500	700	6	10	.5	1.0	----	----
ACC	Altvan-Chappell complex, 5 to 9 percent slopes	11	16	11	15	10	15	11	17	500	700	7	11	.5	1.0	----	----
ACC2	Altvan-Chappell complex, 5 to 9 percent slopes, eroded	9	14	9	13	8	13	8	14	450	650	5	9	.4	.9	----	----
An	Anselmo fine sandy loam, 0 to 1 percent slopes	17	20	19	24	15	18	16	20	600	800	17	22	1.2	1.6	----	----
AnB	Anselmo fine sandy loam, 1 to 5 percent slopes	13	18	15	19	11	16	12	18	500	700	16	21	.8	1.2	----	
AnC	Anselmo fine sandy loam, 5 to 9 percent slopes	8	13	11	15	8	13	8	14	450	650	10	15	.6	1.1	----	----
AoBW	Anselmo loamy fine sand, 0 to 5 percent slopes	11	16	9	14	9	14	10	15	450	650	9	13	.7	1.2	----	----
AoCW	Anselmo loamy fine sand, 5 to 9 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Bf	Bayard fine sandy loam, 0 to 1 percent slopes	17	20	19	24	15	18	16	20	600	800	17	22	1.2	1.6	----	----
Bw	Bayard loam, 0 to 1 percent slopes	18	22	20	25	16	20	18	23	600	800	16	21	1.5	2.0	0.6	0.6
BH	Bridgeport and Havre loams, 0 to 1 percent slopes	19	24	21	26	18	23	19	25	600	800	17	22	1.6	2.0	----	----
BHA	Bridgeport and Havre loams, 1 to 3 percent slopes	18	23	20	25	17	22	18	24	550	750	15	20	1.4	1.9	----	----
CD	Canyon complex	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
ChA	Chappell sandy loam, 0 to 3 percent slopes	12	17	11	16	11	16	11	16	500	700	9	13	.9	1.4	----	----
Cy	Cheyenne loam, 0 to 1 percent slopes	17	22	19	24	16	20	17	22	600	750	11	16	1.2	1.6	----	----
CyA	Cheyenne loam, 1 to 3 percent slopes	15	20	18	23	14	18	16	21	550	700	10	15	1.0	1.4	----	----
CUB	Colby-Ulysses silt loams, 3 to 5 percent slopes	14	20	12	17	12	18	14	21	500	700	7	12	.8	1.3	----	----
CUD	Colby-Ulysses silt loams, 5 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
DK	Dawes-Keith loams, 0 to 1 percent slopes	19	22	19	23	18	21	19	23	650	850	11	15	1.2	1.6	----	----
DKA	Dawes-Keith loams, 1 to 3 percent slopes	18	21	18	22	17	20	18	22	650	850	10	14	1.0	1.4	----	----
DxD	Dix complex, 5 to 20 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
DxE	Dix complex, 20 to 30 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
DCD	Dix-Chappell loams, 9 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Du	Dunday loamy fine sand	10	15	9	14	8	13	9	14	450	650	8	12	.6	1.0	----	----
Gf	Goshen fine sandy loam, 0 to 3 percent slopes	28	30	27	30	24	26	27	31	850	1050	20	24	1.6	2.0	----	----
Gh	Goshen silt loam, 0 to 1 percent slopes	30	31	28	31	26	28	30	33	900	1100	20	24	1.8	2.2	----	----
GhA	Goshen silt loam, 1 to 3 percent slopes	28	30	27	30	24	26	28	31	850	1050	18	22	1.6	2.0	----	----
KeB	Keith silt loam, 3 to 5 percent slopes	19	24	20	25	17	22	19	25	600	800	13	18	1.2	1.7	----	----
KeB2	Keith silt loam, 3 to 5 percent slopes, eroded	17	23	17	22	16	21	17	24	550	750	11	16	1.1	1.6	----	----
KeC	Keith silt loam, 5 to 9 percent slopes	17	23	17	22	15	21	17	23	550	750	9	13	1.0	1.5	----	----
KeC2	Keith silt loam, 5 to 9 percent slopes, eroded	14	20	12	16	12	18	14	20	500	700	7	11	.8	1.3	----	----
KK	Keith-Kuma silt loams, 0 to 1 percent slopes	24	29	25	30	22	26	24	30	750	950	18	23	1.6	2.0	----	----
KR	Keith-Richfield silt loams, 0 to 1 percent slopes	23	28	24	29	20	25	23	30	750	950	17	22	1.6	2.0	----	----
KRA	Keith-Richfield silt loams, 1 to 3 percent slopes	21	26	22	28	19	24	21	28	700	900	15	20	1.4	1.9	----	----
KT	Keith and Tripp fine sandy loams, 0 to 3 percent slopes	19	24	21	26	17	22	19	25	600	800	17	22	1.2	1.7	----	----
KTB	Keith and Tripp fine sandy loams, 3 to 5 percent slopes	17	22	19	24	15	20	16	22	550	750	14	19	1.1	1.6	----	----
KTB2	Keith and Tripp fine sandy loams, 3 to 5 percent slopes, eroded	14	20	17	22	12	18	13	20	500	700	10	15	.9	1.4	----	----
KTC2	Keith and Tripp fine sandy loams, 5 to 9 percent slopes, eroded	11	17	12	17	10	16	10	17	450	650	7	11	.6	1.0	----	----

TABLE 3.—*Predicted average acre yields of principal crops grown on dry-farmed soils under two levels of management*—Continued

[Yields in columns A are those obtained under common management; those in columns B are yields to be expected under high-level management. Presence of yield does not necessarily mean that crop is grown on soil, but dashed lines indicate that crop is not grown on soil]

Map symbol	Soil	Wheat		Grain sorghum		Winter barley		Oats		Safflower		Corn		Forage sorghum		Wild hay	
		A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
		Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Lbs.*	*Lbs.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Lt	Las loam	19	22	20	25	17	20	19	23	550	750	20	23	1.8	2.2	0.8	0.8
Lc	Las Animas fine sandy loam	12	17	14	19	10	15	11	17	550	700	16	20	1.6	2.0	.8	.8
Lw	Las Animas loamy sand	10	15	10	15	8	13	9	15	400	550	10	14	1.3	1.7	.8	.8
LS	Laurel soils	----	----	----	----	----	----	----	----	----	----	----	----	----	----	.3	.3
Na	Nunn silt loam	21	25	21	27	19	23	21	26	700	900	15	20	1.4	1.9	----	----
NS	Nunn-Slickspots complex	11	16	10	15	10	15	11	17	500	700	7	11	.5	1.0	.5	.5
RdB	Rosebud fine sandy loam, 3 to 5 percent slopes	13	18	14	19	11	16	13	19	550	750	11	15	1.0	1.5	----	----
RdB2	Rosebud fine sandy loam, 3 to 5 percent slopes, eroded	10	15	10	15	9	14	10	16	500	700	9	13	.8	1.3	----	----
RdC	Rosebud fine sandy loam, 5 to 9 percent slopes	11	16	10	14	10	15	11	17	500	700	8	12	.7	1.2	----	----
RdC2	Rosebud fine sandy loam, 5 to 9 percent slopes, eroded	8	13	8	13	7	12	8	14	450	650	5	9	.6	1.0	----	----
RbA	Rosebud loam, 0 to 3 percent slopes	20	25	21	26	18	23	20	26	600	800	11	15	1.2	1.7	----	----
RbB	Rosebud loam, 3 to 5 percent slopes	16	22	17	22	15	20	16	23	550	750	9	13	1.0	1.5	----	----
RbB2	Rosebud loam, 3 to 5 percent slopes, eroded	13	20	14	19	12	18	13	20	500	700	7	11	.8	1.3	----	----
RCC	Rosebud-Canyon complex, 5 to 9 percent slopes	14	20	12	16	12	18	14	21	500	700	6	9	.8	1.1	----	----
RCC2	Rosebud-Canyon complex, 5 to 9 percent slopes, eroded	11	16	9	13	9	15	11	17	450	650	4	7	.6	1.0	----	----
RCD	Rosebud-Canyon complex, 9 to 15 percent slopes	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Sx	Sandy alluvial land	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Sc	Scott silty clay loam	0	0	5	5	0	0	0	0	0	0	0	0	.7	.7	----	----
Ss	Slickspots	----	----	----	----	----	----	----	----	----	----	----	----	----	----	.4	.4
TK	Tripp-Keith silt loams, 0 to 1 percent slopes	23	28	24	29	21	26	23	30	750	950	17	22	1.6	2.0	----	----
TKA	Tripp-Keith silt loams, 1 to 3 percent slopes	22	27	22	28	20	25	22	29	700	900	15	20	1.4	1.9		
VaC	Valentine fine sand, rolling	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
VaD	Valentine fine sand, hilly	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Wm	Wann loam	17	20	20	25	15	18	17	21	550	750	20	23	1.8	2.2	.8	.8
Wx	Wet alluvial land	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

dictions are averages over a period of years, not yields for any particular year.

The yields in columns A are those to be expected under common management, or the management practiced by most farmers in the county. Under such management, a farmer does not carry out all the practices that management at a high level requires. The yields in columns B are to be expected when management is at a high level.

To keep management of dry-farmed soils at a high level and obtain the yields in columns B of table 3, a farmer must:

1. Use practices that control erosion and conserve water.
2. Use suitable cropping systems.
3. Cultivate, seed, and fallow the soil with care.
4. Plant suitable crop varieties.
5. Obtain a full stand of crops.
6. Use insect and disease controls consistently.
7. Apply fertilizer according to needs indicated by soil tests.

To keep management of irrigated soils at a high level and obtain the yields in columns B of table 4, a farmer must:

1. Apply irrigation water properly.
2. Plant suitable crops, and use suitable cropping systems.
3. Use practices to control erosion.
4. Plow, plant, and cultivate with care.
5. Plant an ample amount of seed to obtain a full stand of crops.
6. Use insect and disease controls consistently.
7. Apply fertilizer as indicated by soil tests.

Under dryfarming in Deuel County, hail, wind, and drought tend to equalize the yields of crops grown on different soils. Because damage to crops varies from acre to acre and from year to year, partial or complete crop failures caused by hail or drought cannot be correlated accurately with the soils.

On irrigated soils weather affects yields of crops much less than on dry-farmed soils. Irrigation provides water

TABLE 4.—*Predicted average acre yields of principal crops grown on irrigable soils under two levels of management*

[Yields in columns A are those obtained under common management; those in columns B are yields to be expected under high-level management]

Map symbol	Soil	Corn		Alfalfa		Sugar beets	
		A	B	A	B	A	B
		Bu.	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*
Bf	Bayard fine sandy loam, 0 to 1 percent slopes	60	95	3.3	4.0	14	18
Bw	Bayard loam, 0 to 1 percent slopes	55	85	2.8	3.8	14	18
BH	Bridgeport and Havre, loams, 0 to 1 percent slopes	65	95	3.4	3.9	16	19
BHA	Bridgeport and Havre loams, 1 to 3 percent slopes	55	85	3.1	3.7	15	18
ChA	Chappell sandy loam, 0 to 3 percent slopes	40	70	2.4	3.4	10	15
Cy	Cheyenne loam, 0 to 1 percent slopes	60	90	2.9	3.9	13	17
CyA	Cheyenne loam, 1 to 3 percent slopes	50	80	2.5	3.6	12	16
Lt	Las loam	50	80	2.5	3.5	10	15
Lc	Las Animas fine sandy loam	40	70	2.4	3.4	10	15
Lw	Las Animas loamy sand	35	65	2.1	3.1	9	12
LS	Laurel soils	25	50	1.2	2.2	8	11
Na	Nunn silt loam	65	100	3.5	4.0	15	17
NS	Nunn-Slickspots complex	45	80	2.7	3.7	13	17
Ss	Slickspots	15	50	1.0	2.0	7	10
TK	Tripp-Keith silt loams, 0 to 1 percent slopes	70	100	3.5	4.0	17	20
TKA	Tripp-Keith silt loams, 1 to 3 percent slopes	65	90	3.2	3.8	16	19
Wm	Wann loam	45	80	2.7	3.8	10	15

when it is needed and, consequently, crops are not affected by a shortage of natural moisture. Wind erosion can easily be controlled by carefully planning the sequence of crops and properly managing the soils. Damage from hail is a hazard, but sugar beets and some other crops grown under irrigation are damaged less severely than is dry-farmed wheat.

Under dryland farming and irrigation farming, the soils in each capability unit are suitable for the same uses and need the same management, but crop yields may differ from one soil to the next in the same unit and generally differ from place to place on the same soil.

Use and Management of Rangeland[2]

At the time of early explorations and settlement, the cover on Deuel County was principally grass. Although much of the original grassland has been plowed, about 22 percent of the county is still covered by native grass. The rangeland is mainly in the southern part of the county, where it borders Lodgepole Creek, Sand Draw, O'Neil Draw, Walrath Draw, Dry Creek, and the South Platte River. It occurs chiefly on steep slopes, in areas of sand or gravel, and in areas that have a high water table or are strongly affected by salts and alkali.

Nearly all the native grass on uplands is grazed, but in areas that have a high water table, the grass is cut for hay. Large ranges are managed as ranches and are used to graze breeding herds. Some ranches have bottom land on Lodgepole Creek or the South Platte River that produces the hay and roughage needed for livestock on the ranch. Small ranges provide grazing for yearlings or small herds of cows. Pasturing of fields sown to wheat and of wheat aftermath are common practices.

[2] LORENZ F. BREDEMEIER, range conservationist, Soil Conservation Service, wrote this subsection.

The income from the products of range livestock amounted to about one-third the income from all agricultural products sold in 1959.

Range sites and range condition

The rancher or the livestock farmer can best manage his rangeland if he knows the different range sites on his holdings and can identify the kinds and combinations of native plants that represent climax vegetation on each site. Also, he needs to be able to recognize changes in the plant cover that indicate whether his range is getting better or worse.

A *range site* is an area of natural grazing land sufficiently uniform in climate, soils, and topography to produce a particular climax, or original, vegetation. Because the combination of climate, soils, and topography differs from one range site to another, a given site needs management different from that of other sites if the desirable plants are to be maintained or improved.

The original, or *climax*, vegetation is the combination of plants that grew on the range site before the plant cover was altered by intensive grazing or by plowing. It is the combination of forage plants that is most productive and that will persist without the aid of tillage, fertilizer, and replanting.

Under prolonged heavy grazing, range plants react in different ways. Some kinds of plants decrease, some increase, and others not originally present invade. *Decreasers* are plants of the original plant community that decrease in amount of herbage they contribute to the total cover if they are closely and continuously grazed. *Increasers* are plants of the original cover that normally increase, at least for a time, in the relative amount of total herbage they produce. They increase as the decreasers cover less of the site. *Invaders* are plants not in the original community that start growing in an area after the decreasers and the increasers have been weakened or

eliminated. A rancher tries to manage his range so that it has a large amount of decreasers and fewer increasers or invaders, for then he keeps his range in desirable condition.

The condition of the range is determined by comparing the kind and vigor of the plants that now occupy an area with the plants that originally grew there. In making this comparison, the rancher estimates the percentage of the present vegetation made up of plants that grew in the climax vegetation. Condition classes based on this percentage have been established (*6*). A range is in *excellent condition* if 76 to 100 percent of the vegetation is of the same kind as the original stand. It is in *good condition* if the percentage is 51 to 75, in *fair condition* if the percentage is 26 to 50, and in *poor condition* if the percentage is less than 25.

As range condition deteriorates under close grazing (fig. 15), the same area of land is successively occupied by many kinds of plants in many combinations. The changes take place gradually and commonly are not recognized until the desirable forage plants are seriously weakened or destroyed. On range that is well managed, the improvements are gradual in a similar way.

For this reason, the rancher needs to know the condition of his range and whether it is deteriorating or improving. He wants to keep his range in excellent or good condition because such range produces the highest yields and has the best cover of plants for conserving moisture and protecting the soils.

To aid the rancher in managing rangeland, the soils of the county have been grouped in 11 range sites, which are described in the following pages.

SUBIRRIGATED RANGE SITE

The soils in this range site have a water table that is within reach of plant roots most of the growing season. During the season, the water table fluctuates but rarely rises to the surface. About 2 percent of the county is made up of this site. The soils are—

Las loam.
Las Animas fine sandy loam.
Las Animas loamy sand.
Wann loam.

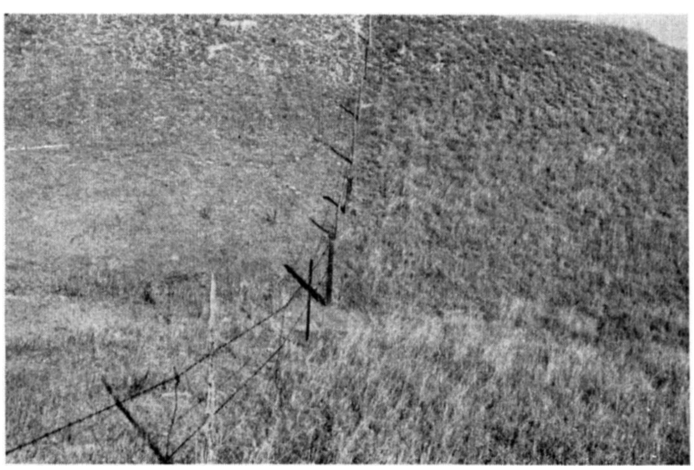

Figure 15.—**The range on the left has been severely overused. That on the right has been well managed.**

When this range site is in excellent condition, switchgrass, big bluestem, and Indiangrass are dominant and generally account for 70 to 90 percent of the herbage. Under close grazing, these grasses decrease and western wheatgrass, tall dropseed, and sand dropseed increase. As the range condition declines, inland saltgrass and Kentucky bluegrass commonly invade the site.

SALINE SUBIRRIGATED RANGE SITE

This range site consists of soils that are subirrigated and contain enough salts, alkali, or both to affect the kinds of plants that grow. In most places salt-tolerant plants make up a large part of the cover. The site occupies about 0.5 percent of the county. The soils are—

Laurel soils.
Slickspots.

When this range site is in excellent condition, the most important grasses are alkali sacaton, western wheatgrass, switchgrass, and inland saltgrass. If the site is overgrazed, alkali sacaton, western wheatgrass, and switchgrass decrease and inland saltgrass, plains bluegrass, and sand dropseed increase.

OVERFLOW RANGE SITE

The soils in this range site lie in upland swales and depressions that regularly receive water in runoff from higher land. The site accounts for about 6.5 percent of the county. The soils are—

Goshen fine sandy loam, 0 to 3 percent slopes.
Goshen silt loam, 0 to 1 percent slopes.
Goshen silt loam, 1 to 3 percent slopes.
Scott silty clay loam.

Western wheatgrass and switchgrass are the most important plants on this range site when it is in excellent condition. If the site is overgrazed, green needlegrass, switchgrass, slender wheatgrass, and Canada wildrye decrease and western wheatgrass, blue grama, and sand dropseed increase. As the range deteriorates, buffalograss and inland saltgrass invade the site.

SANDS RANGE SITE

In this range site are deep, loose fine sand and loamy fine sand that occur on complex, hummocky slopes of 3 to 20 percent. The site covers about 1.5 percent of the county. The soils are—

Anselmo loamy fine sand, 5 to 9 percent slopes.
Valentine fine sand, rolling.

When this range site is in excellent condition, the dominant grasses are sand bluestem, switchgrass, prairie sandreed, needle-and-thread, and little bluestem. If the range is overgrazed, sand bluestem, little bluestem, and switchgrass decrease and prairie sandreed, needle-and-thread, sand dropseed, and blue grama increase. As the range condition declines, western ragweed, sand paspalum, and annuals invade the site.

SANDY RANGE SITE

The soils in this range site are sandy loams, fine sandy loams, and dark-colored loamy fine sands. These soils are nearly level to rolling and occur on colluvial slopes, terraces, and uplands. The site makes up about 7 percent of the county. The soils are—

Anselmo fine sandy loam, 0 to 1 percent slopes.
Anselmo fine sandy loam, 1 to 5 percent slopes.

Anselmo fine sandy loam, 5 to 9 percent slopes.
Anselmo loamy fine sand, 0 to 5 percent slopes.
Bayard fine sandy loam, 0 to 1 percent slopes.
Chappell sandy loam, 0 to 3 percent slopes.
Dunday loamy fine sand.
Keith and Tripp fine sandy loams, 0 to 3 percent slopes.
Keith and Tripp fine sandy loams, 3 to 5 percent slopes.
Keith and Tripp fine sandy loams, 3 to 5 percent slopes, eroded.
Keith and Tripp fine sandy loams, 5 to 9 percent slopes, eroded.
Rosebud fine sandy loam, 3 to 5 percent slopes.
Rosebud fine sandy loam, 3 to 5 percent slopes, eroded.
Rosebud fine sandy loam, 5 to 9 percent slopes.
Rosebud fine sandy loam, 5 to 9 percent slopes, eroded.

In excellent condition, this range site has a cover that is mainly prairie sandreed, needle-and-thread, western wheatgrass, sand bluestem, and switchgrass. Under prolonged heavy grazing, sand bluestem, switchgrass, and little bluestem decrease and prairie sandreed, needle-and-thread, western wheatgrass, blue grama, sand dropseed, and needleleaf sedge increase. Common invaders are red three-awn, tumblegrass, and false buffalograss.

SILTY RANGE SITE

The soils in this range site are loams, silt loams, and very fine sandy loams on uplands and terraces. These soils are nearly level to rolling and are deep or moderately deep. The site is by far the largest in the county and accounts for 71.5 percent of the total area. The soils are—

Altvan loam, 3 to 5 percent slopes.
Altvan loam, 3 to 5 percent slopes, eroded.
Altvan-Chappell complex, 5 to 9 percent slopes.
Altvan-Chappell complex, 5 to 9 percent slopes, eroded.
Bayard loam, 0 to 1 percent slopes.
Bridgeport and Havre loams, 0 to 1 percent slopes.
Bridgeport and Havre loams, 1 to 3 percent slopes.
Cheyenne loam, 0 to 1 percent slopes.
Cheyenne loam, 1 to 3 percent slopes.
Dawes-Keith loams, 0 to 1 percent slopes.
Dawes-Keith loams, 1 to 3 percent slopes.
Keith silt loam, 3 to 5 percent slopes.
Keith silt loam, 3 to 5 percent slopes, eroded.
Keith silt loam, 5 to 9 percent slopes.
Keith silt loam, 5 to 9 percent slopes, eroded.
Keith-Kuma silt loams, 0 to 1 percent slopes.
Keith-Richfield silt loams, 0 to 1 percent slopes.
Keith-Richfield silt loams, 1 to 3 percent slopes.
Nunn silt loam.
Nunn-Slickspots complex.
Rosebud loam, 0 to 3 percent slopes.
Rosebud loam, 3 to 5 percent slopes.
Rosebud loam, 3 to 5 percent slopes, eroded.
Rosebud-Canyon complex, 5 to 9 percent slopes.
Rosebud-Canyon complex, 5 to 9 percent slopes, eroded.
Tripp-Keith silt loams, 0 to 1 percent slopes.
Tripp-Keith silt loams, 1 to 3 percent slopes.

When the site is in excellent condition, the principal grasses are western wheatgrass, needle-and-thread, blue grama, and side-oats grama. If the range is overgrazed, western wheatgrass, side-oats grama, and green needlegrass decrease and needle-and-thread, blue grama, and threadleaf sedge increase. As the range deteriorates, buffalograss, red three-awn, and tumblegrass invade the site.

CHOPPY SANDS RANGE SITE

The only soil in this range site is Valentine fine sand, hilly. This soil lies on abruptly irregular slopes of hills and dunes that rise to narrow peaks or ridges. It is deep and loose and shows only slight differences from the surface downward. The plant cover is fairly thin, and sand has shifted about in overgrazed places. About 0.1 percent of the county is made up of this site.

When the site is in excellent condition, the main grasses are little bluestem, sand bluestem, prairie sandreed, and needle-and-thread. If the range is overgrazed, sand bluestem and little bluestem decrease and prairie sandreed, needle-and-thread, sand dropseed, and blue grama increase. Sandhill muhly, sand paspalum, and annuals are common invaders.

THIN SILTY RANGE SITE

In this range site are deep, silty soils that generally occupy narrow ridgetops. These soils have a thin surface layer and lack a well-developed B horizon. In most places slopes are about 10 percent. The site makes up only about 1 percent of the county. The soils are—

Colby-Ulysses silt loams, 3 to 5 percent slopes.
Colby-Ulysses silt loams, 5 to 15 percent slopes.

When this range site is in excellent condition, the main plants are little bluestem, side-oats grama, needle-and-thread, and threadleaf sedge. Under heavy grazing, little bluestem, side-oats grama, and needle-and-thread decrease and threadleaf sedge, blue grama, and sand dropseed increase. If overgrazing continues, annual bromes, croton, sixweeks fescue, and other annuals invade the site.

SHALLOW TO GRAVEL RANGE SITE

This range site consists of dominantly shallow soils that occur on rolling to steep slopes (fig. 16) and in dry, gravelly channels of small drainageways. Gravelly or cobbly material generally occurs at a depth of 10 to 20 inches but is at the surface in some places. Only a few plant roots penetrate this material. The site makes up about 6 percent of the county. The soils are—

Dix complex, 5 to 20 percent slopes.
Dix-Chappell loams, 9 to 15 percent slopes.
Sandy alluvial land.

When this range site is in excellent condition, the principal grasses are needle-and-thread, blue grama, threadleaf sedge, side-oats grama, and western wheatgrass. Under prolonged heavy grazing, needle-and-thread, side-oats grama, and western wheatgrass decrease and blue grama, threadleaf sedge, sand dropseed, and buffalograss

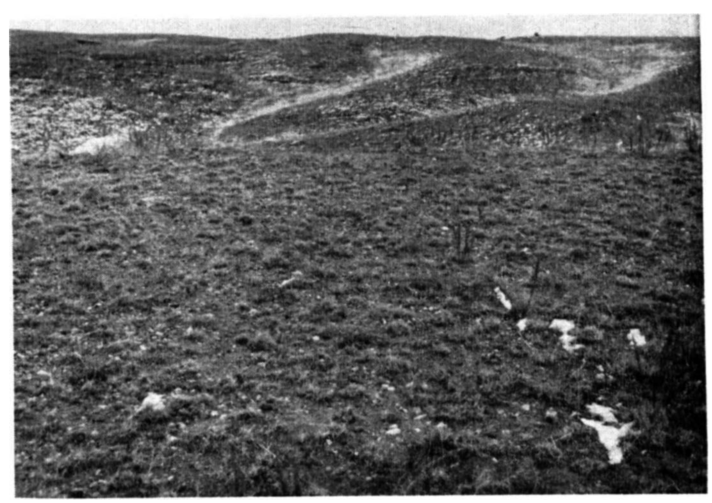

Figure 16.—**Landscape of the Shallow to Gravel range site in the southeastern part of the county, photographed in November when small patches of snow covered the ground.**

increase. Common invaders are the three-awns and annual plants.

SHALLOW LIMY RANGE SITE

In this range site are dominantly shallow, limy soils that occur on knolls and other sloping areas. These soils generally are underlain by highly calcareous sandstone and siltstone at a depth of 10 to 20 inches, but rock crops out in places. The underlying rock checks penetration of plant roots. Only about 0.5 percent of the county is in this site. The soils are—

Canyon complex.
Rosebud-Canyon complex, 9 to 15 percent slopes.

The most important grasses on this range site when it is in excellent condition are needle-and-thread, blue grama, side-oats grama, little bluestem, threadleaf sedge, and buffalograss. Also commonly present are plains muhly, prairie junegrass, western wheatgrass, red three-awn, fendler three-awn, and broom snakeweed. If the site is overgrazed, side-oats grama, needle-and-thread, little bluestem, and western wheatgrass decrease and blue grama, threadleaf sedge, buffalograss, red and fendler three-awns, and broom snakeweed increase. The main invaders are annuals.

VERY SHALLOW POROUS RANGE SITE

The soils of this range site are underlain by clean gravel and stones at a depth of generally less than 10 inches. The gravel is near the surface at the upper part of slopes and is somewhat deeper at the lower part. Many ridgetops have pebbles and stones at the surface. Few roots penetrate the gravel. The site makes up about 3.4 percent of the county. The soils are—

Dix complex, 20 to 30 percent slopes.
Wet alluvial land.

When this site is in excellent condition, the principal grasses are little bluestem, side-oats grama, threadleaf sedge, hairy grama, and blue grama. Less important plants are prairie junegrass, slimflower scurfpea, needle-and-thread, red three-awn, and mat-forming plants. Plants that decrease under close grazing are little bluestem, side-oats grama, prairie junegrass, needle-and-thread, and slimflower scurfpea. Increasers are blue grama, threadleaf sedge, and red three-awn. The main invaders are annuals.

Principles of grazing management

Practices of grazing management can be used to improve the plant cover, increase the amount of forage produced, stabilize ranching operations, and conserve soil and water. Successfully managing rangeland depends on (1) proper degree of range use; (2) proper season of use; (3) uniform distribution of grazing throughout the pasture, and (4) proper kinds of grazing animals.

PROPER DEGREE OF RANGE USE

The proper degree of range use refers to the amount of the current year's growth that is removed through grazing by the end of the growing season. Because plant food is manufactured chiefly in the leaves, removing them in large amounts retards the growth processes of the plant (*5*). Excessive removal weakens the plant, reduces its capacity to produce new leaves, and makes it less capable of competing with the plants around it.

Ranchers have learned that proper use of range means grazing not more than half of the growth made by the important forage plants in one year. This is commonly referred to as "take half and leave half" and is only a rule of thumb because some plants withstand greater use than others. Proper use is obtained by adjusting either the number of animals or the length of the grazing period. Because the amount of forage produced on range fluctuates from year to year, proper use can be judged only by examining the plants. Proper degree of grazing is the first and most important step in range management.

Plants are damaged little on well-managed range, and consequently, they improve in vigor and forage production. The forage that is left ungrazed controls erosion and, by reducing runoff, enables the soil to absorb more water that plants can use. If properly grazed, the plants grow rapidly and vigorously in spring and send their roots deep into the soil for moisture. The more aggressive and more productive grasses crowd out weeds. The ungrazed forage provides a reserve for dry spells that otherwise might force the rancher to sell his livestock at a loss.

PROPER SEASON OF USE

The proper time to graze a range depends on the growth period of the main plants and the condition of the range. Also to be considered is the need of livestock for forage, because livestock make their best gains at the same time of year that grasses respond best to rest but are very susceptible to damage from grazing. This time is between May 1 and the first part of July. Range in Deuel County can be grazed whenever it is not covered by snow, but grasses improve most if the range is rested during the entire growing season.

Deferred grazing is valuable in speeding range improvement. Pasture protected from livestock during the growing season can be grazed when the plants are dormant, but enough growth should be left to maintain a mulch that protects the soil and promotes the intake of water.

UNIFORM DISTRIBUTION OF GRAZING

Livestock tend to graze most in areas that are nearly level, easily accessible, and close to water. If they are forced to graze in remote and nearly inaccessible areas, other parts of the pasture are likely to be damaged. Livestock must be enticed into undergrazed areas or kept there by fences or herders.

Fences can be used to improve distribution of grazing by separating different kinds of range sites. The Subirrigated range site, for example, should be separated from the Sandy site, the Silty site, and other sites on the uplands. In pasture that is excessively large and irregularly shaped, fences are needed to establish smaller grazing units.

Livestock can be encouraged to graze pasture uniformly by installing wells or ponds for stockwater in or near undergrazed areas. Placing salt, minerals, and other supplements in lightly grazed areas helps to obtain proper distribution.

PROPER KINDS OF GRAZING ANIMALS

Range in Deuel County is suited to cattle and to sheep. In most places it is grazed by cattle. In selecting the grazing animals suitable for a range, the forage, the soils, and the climate are considered. Cattle generally do best

on ranges that are mostly in grass, and sheep do best where the forage contains a large amount of broad-leaved plants and browse.

Range seeding

Most soils of the county can be successfully seeded to a mixture of native grasses. Such seedings are needed on soils that are now in crops but are not suitable for cultivation. To establish a seeding of grasses, it is first necessary to prepare a good seedbed. By growing sorghum for 1 or 2 years, weed competition is reduced and a cover of stubble is produced. The grass seed is then drilled in the sorghum stubble. The best time for seeding is from March 1 to May 1, but successful stands can be obtained by planting in thick stubble at any time between November 1 and May 15. The mixture should be one that will restore the grasses that accounted for most of the forage in the original plant cover.

Newly seeded grass should not be grazed during the first two growing seasons, though generally it can be safely used in fall and winter if the grazing is light. The seeded area should be fenced until the cover of grass inside the fence is as thick and well developed as that outside.

Additional information on seeding mixtures, adapted strains, seedbed preparation, methods of seeding, and management of new seedlings can be obtained from the Agricultural Extension office or from the United States Department of Agriculture.

Management of native meadows

Areas of native grasses that are mowed for hay are called meadows. These meadows cover more than 8,000 acres in Deuel County. Most of them are on soils in the Subirrigated range site, but native grasses in some areas of the Saline Subirrigated range site also are cut for hay.

A good stand of tall grasses can be maintained, and production can be kept at a high level, if the grass is mowed only once a year and is mowed early enough to allow ample regrowth of leaves and of many seed stalks. The regrowth can be grazed after the end of the growing season.

Conservation on rangeland

Conserving water is the main need on rangeland in this county. Water can be conserved most effectively if range is covered by a thick growth of native plants. The plant cover is maintained through the proper management of grazing.

Among the practices that slow runoff and reduce erosion on rangeland are pitting and contour furrowing. If either of these practices is used, grazing should then be deferred long enough for the desirable mid grasses to seed naturally in the pits or the furrows. Research has shown that both pitting and furrowing increase forage yields because they encourage the growth of mid grasses (*15*).

Woodland and Windbreaks [3]

Native woodland occurs in only small areas of Deuel County. In the valleys of the larger streams are scattered redcedar, cottonwood, American elm, hackberry, ash, boxelder, American plum, and black, sandbar, and peachleaf willows. Trees are generally sparse along Lodgepole Creek, though a few clumps do occur (fig. 17). Willow and cottonwood, the most common trees along the South Platte River, are mainly on the fairly permanent sandbars in the channel. Deuel County has no natural forests, and its native trees are of little commercial value.

Planting trees

The early settlers planted trees under the Timber Culture Act, which offered land free to settlers who established trees in plantations. Because of neglect and adverse climate, the plantations commonly failed, though the uplands still are sparingly dotted with remnants of the early timber claims. The trees, chiefly ash and boxelder, are small and stunted.

The damage and discomfort caused by hot winds in summer and severe storms in winter have resulted in continuing efforts to establish windbreaks in Deuel County, especially around farm buildings. If trees are managed and cared for, they can be grown in the county. By properly preparing the soil before planting, by protecting the trees from injury, and by carefully cultivating the soil for 6 or 7 years after planting, a windbreak can be established with little difficulty.

Preparing the site.—To start trees successfully, the planting site must be carefully prepared. The amount of preparation needed varies for different soils and different sites. On fine-textured soils and in fields covered by sod or alfalfa, stubble-mulch fallow is needed for 1 year to store moisture and to thin the competing plants. Medium-textured soils in cropped fields can generally be prepared by using subsurface tillage in fall or by plowing and disking in spring.

In areas of Anselmo fine sandy loam, Chappell sandy loam, Keith and Tripp fine sandy loams, Rosebud fine sandy loam, and similar soils, prepare only a narrow band for each row of trees and leave a strip of sod or of crop stubble between the rows to control soil blowing. If a protective cover is thin or lacking, sorghum, sudangrass, or corn should be planted a year before the trees are planted. In very sandy areas of grassland where culti-

***Figure 17.*—A clump of willow, ash, and cottonwood in the valley of Lodgepole Creek.**

[3] SIDNEY S. BURTON, woodland conservationist, Soil Conservation Service, wrote this subsection.

vation is nearly impossible, redcedar and pine can be successfully grown in shallow furrows 18 to 20 inches wide, preferably on the approximate contour.

Designing windbreaks.—Windbreaks planted to protect farmsteads or livestock in winter are best if they are wide enough to hold most of the drifting snow within the belt. They should be located on the north and west sides of the area to be protected and about 100 feet from the main buildings.

Low shrubs, medium-sized trees or shrubs, and tall trees planted in combination provide a satisfactory wind barrier. Adequate protection is obtained in winter if the windbreak is 50 percent or more redcedar, pine, or other conifers. Such a windbreak has a longer effective life than one made up entirely of deciduous trees and shrubs. Redcedar makes an excellent outside row because its branches grow densely to the ground (fig. 18).

Windbreaks about the farmstead are valuable in many ways. They keep snow from drifting into the yard and feedlot, reduce the cost of heating the farm home, provide shelter for livestock, reduce the cost of feeding livestock, invite insectivorous birds and other wildlife, protect the garden, and beautify the farmstead.

Field windbreaks.—Field windbreaks are of particular value in controlling wind erosion on coarse-textured soils used for crops. These belts of trees afford protection for a distance equal to about 20 times their height. A cultivated field, therefore, can be completely protected by planting a series of belts at regular intervals across it. Wide belts are not necessary. Belts consisting of one or two rows are dense enough to reduce the wind velocity, yet they allow snow to drift through and to cover the field fairly well. Redcedar, pine, honeylocust, green ash, and mulberry are suitable for field windbreaks because they do not remove too much moisture from the soil and do not compete with crops.

A complete pattern of field windbreaks helps to control soil blowing, increases soil moisture by holding snow on the field, prevents strong winds from damaging crops, and furnishes food and cover for wildlife.

Woodland sites

The soils of Deuel County have been placed in six woodland sites. Each site is made up of soils that are suited to the same kinds of trees and that need similar management. Table 5 lists the woodland sites, the soils in each site, and the trees suited to each site.

A few soils and miscellaneous land types are too wet, too shallow, or too strongly saline-akali for planting of trees and are not included in a woodland site. They are Slickspots, Laurel soils, Sandy alluvial land, Wet alluvial land, and Dix complex, 20 to 30 percent slopes.

Maintaining tree plantings

Plantings of trees need care and protection. The soil should be clean cultivated until the young trees are large enough to form a canopy that shades out weeds and grasses. Cultivation is generally needed for 6 to 8 years. Newly planted trees grow more rapidly, and more of them survive, if cultivation is confined to the tree rows and if the strips between rows are planted to corn, sorghum, or other tall cover crops that protect the plantings from strong winds and the hot sun.

Figure 18.—**Redcedar, pine, and other conifers make up a large windbreak protecting the west side of a farmstead. Visible are the marks made in cultivating.**

If a good wind barrier is to be maintained, livestock must be kept away from the planting permanently.

Use of Soils in Engineering [4]

Some properties of soils are of special interest to engineers because they affect the construction and maintenance of highways and roads, airports, pipelines, foundations of buildings, earth dams for storing water and controlling erosion, and facilities for irrigating and draining soils, disposing of sewage, and conserving soil and water. Some of these properties are soil texture, permeability, shear strength, plasticity, moisture-density relationships, compressibility, workability, and water-holding capacity. Also of interest to engineers is information on topography, the water table, and the depth to bedrock or to sand and gravel.

In this section the properties of soils that most affect engineering are interpreted. Engineers can use these interpretations to—

1. Make soil and land use studies that will aid in selecting and developing industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils that will help in planning farm ponds, diversion terraces, irrigation systems, agricultural drainage systems, and other measures used to conserve soil and water.
3. Make preliminary evaluations of soil and ground conditions that will aid in selecting locations for highways and airports and in planning detailed investigations at the selected locations.
4. Estimate drainage areas and runoff characteristics for use in designing culverts and bridges.

[4] Prepared by LEE E. SMEDLEY, assistant State conservation engineer, Soil Conservation Service, with the assistance of WILLIAM J. RAMSEY, geologist, Division of Materials and Tests, Nebraska Department of Roads. The assistance of the Department of Roads was provided under cooperative agreement with the Bureau of Public Roads, U.S. Department of Commerce.

TABLE 5.—*Woodland sites and species suitable for planting*

Description of site, practices, and suitable planting stock	Soils in woodland site	Map symbol
SILTY TO CLAYEY WOODLAND SITE		
Deep, well-drained, silty, clayey, or claypan soils, except saline-alkali soils: Trees, once established, grow satisfactorily. Wind, blowing soil, and drought are the chief hazards. These hazards can be overcome by cover cropping, summer-fallow preparation of the site, clean cultivation, and watering when possible. Suitable for planting: Shrubs: American plum, western chokecherry, common lilac, Tatarian honeysuckle, cottoneaster. Conifers: redcedar, Rocky Mountain juniper, ponderosa pine, Austrian pine. Low broadleaf: boxelder, mulberry. Medium and tall broadleaf: green ash, honeylocust, Siberian elm.	Altvan loam, 3 to 5 percent slopes	3AB
	Altvan loam, 3 to 5 percent slopes, eroded	3AB2
	Altvan-Chappell complex, 5 to 9 percent slopes	ACC
	Altvan-Chappell complex, 5 to 9 percent slopes, eroded	ACC2
	Bayard loam, 0 to 1 percent slopes	Bw
	Bridgeport and Havre loams, 0 to 1 percent slopes	BH
	Bridgeport and Havre loams, 1 to 3 percent slopes	BHA
	Cheyenne loam, 0 to 1 percent slopes	Cy
	Cheyenne loam, 1 to 3 percent slopes	CyA
	Colby-Ulysses silt loams, 3 to 5 percent slopes	CUB
	Colby-Ulysses silt loams, 5 to 15 percent slopes	CUD
	Dawes-Keith loams, 0 to 1 percent slopes	DK
	Dawes-Keith loams, 1 to 3 percent slopes	DKA
	Goshen silt loam, 0 to 1 percent slopes	Gh
	Goshen silt loam, 1 to 3 percent slopes	GhA
	Keith silt loam, 3 to 5 percent slopes	KeB
	Keith silt loam, 3 to 5 percent slopes, eroded	KeB2
	Keith silt loam, 5 to 9 percent slopes	KeC
	Keith silt loam, 5 to 9 percent slopes, eroded	KeC2
	Keith-Kuma silt loams, 0 to 1 percent slopes	KK
	Keith-Richfield silt loams, 0 to 1 percent slopes	KR
	Keith-Richfield silt loams, 1 to 3 percent slopes	KRA
	Nunn silt loam	Na
	Rosebud loam, 0 to 3 percent slopes	RbA
	Rosebud loam, 3 to 5 percent slopes	RbB
	Rosebud loam, 3 to 5 percent slopes, eroded	RbB2
	Rosebud-Canyon complex, 5 to 9 percent slopes	RCC
	Rosebud-Canyon complex, 5 to 9 percent slopes, eroded	RCC2
	Rosebud-Canyon complex, 9 to 15 percent slopes	RCD
	Tripp-Keith silt loams, 0 to 1 percent slopes	TK
	Tripp-Keith silt loams, 1 to 3 percent slopes	TKA
SANDY WOODLAND SITE		
Moderately sandy soils and nearly level, very sandy soils: Good soils for planting if soil blowing is prevented by cultivating only in tree rows and leaving strips of vegetation between rows. Suitable for planting: Shrubs: American plum, western sandcherry, common lilac. Conifers: redcedar, Rocky Mountain juniper, ponderosa pine. Low broadleaf: boxelder, mulberry. Medium and tall broadleaf: honeylocust, Siberian elm, cottonwood.	Anselmo fine sandy loam, 0 to 1 percent slopes	An
	Anselmo fine sandy loam, 1 to 5 percent slopes	AnB
	Anselmo fine sandy loam, 5 to 9 percent slopes	AnC
	Anselmo loamy fine sand, 0 to 5 percent slopes	AoBW
	Bayard fine sandy loam, 0 to 1 percent slopes	Bf
	Chappell sandy loam, 0 to 3 percent slopes	ChA
	Dunday loamy fine sand	Du
	Goshen fine sandy loam, 0 to 3 percent slopes	Gf
	Keith and Tripp fine sandy loams, 0 to 3 percent slopes	KT
	Keith and Tripp fine sandy loams, 3 to 5 percent slopes	KTB
	Keith and Tripp fine sandy loams, 3 to 5 percent slopes, eroded	KTB2
	Keith and Tripp fine sandy loams, 5 to 9 percent slopes, eroded	KTC2
	Rosebud fine sandy loam, 3 to 5 percent slopes	RdB
	Rosebud fine sandy loam, 3 to 5 percent slopes, eroded	RdB2
	Rosebud fine sandy loam, 5 to 9 percent slopes	RdC
	Rosebud fine sandy loam, 5 to 9 percent slopes, eroded	RdC2
VERY SANDY WOODLAND SITE		
Very sandy soils, and loose, sandy soils that cannot be safely cultivated: Soils are so sandy that trees should be planted in a shallow furrow and not cultivated. Only conifers can succeed on this site. Suitable for planting: Conifers: redcedar, ponderosa pine.	Anselmo loamy fine sand, 5 to 9 percent slopes	AoCW
	Valentine fine sand, hilly	VaD
	Valentine fine sand, rolling	VaC

TABLE 5.—*Woodland sites and species suitable for planting*—Continued

Description of site, practices, and suitable planting stock	Soils in woodland site	Map symbol
MODERATELY WET WOODLAND SITE		
Soils of bottom lands, benches, and upland depressions that are occasionally wet because of high water table or flooding; some areas are flooded frequently for a short time: Good soils for planting if the trees and shrubs can tolerate occasional wetness. Suitable for planting: Shrubs: purple willow, red-osier dogwood, buffaloberry. Conifers: redcedar, Scotch pine. Low broadleaf: diamond willow. Medium and tall broadleaf: golden willow, green ash, white willow, cottonwood, Siberian elm.	Las loam Las Animas fine sandy loam Las Animas loamy sand Scott silty clay loam Wann loam	Lt Lc Lw Sc Wm
MODERATELY SALINE-ALKALI WOODLAND SITE		
Moderately saline or alkali soils: Poor soils for trees and shrubs; suited only to the species most tolerant of salts and alkali. Suitable for planting: Shrubs: buffaloberry, dogwood, American plum, tamarix. Conifers: redcedar. Low broadleaf: Russian olive, diamond willow. Medium and tall broadleaf: green ash, Siberian elm, honeylocust, cottonwood.	Nunn-Slickspots complex	NS
SHALLOW WOODLAND SITE		
Shallow soils having a limited root zone over bedrock, shale, or dry gravel: Only limited tree planting is possible on these shallow soils. Before an area is planted, careful examination should be made to determine the depth of soil. Suitable for planting: Conifers: redcedar and Rocky Mountain juniper.	Canyon complex Dix complex, 5 to 20 percent slopes Dix-Chappell loams, 9 to 15 percent slopes	CD DxD DCD

5. Classify soils along a proposed highway route for use in making preliminary estimates of required thickness of flexible pavements.
6. Estimate the need for clay to stabilize the surfacing on roads that are not paved.
7. Locate deposits of sand, gravel, rock, mineral filler, and soil binder for use in constructing subbase courses, base courses, and surface courses of flexible pavements for highways and for structures.
8. Make preliminary evaluations of topography, surface drainage, subsurface drainage, depth to water table, and other features that need to be considered in designing highway embankments, subgrades, and pavements.
9. Correlate performance of engineering practices and structures with types of soil, and thus develop information that will be useful in designing and maintaining these engineering practices and structures.
10. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
11. Supplement information obtained from other published maps and reports and from aerial photographs for the purpose of making soil maps and reports that can be readily used by engineers.
12. Develop other preliminary estimates for construction purposes, pertinent to the particular area.

This report does not eliminate the need for on-site sampling and testing of soils for the design and construction of specific engineering works. The interpretations should be used primarily in planning more detailed field investigations to determine the condition of soil material at the proposed site.

Some of the terms used by the soil scientist may be unfamiliar to the engineer, and some words have special meanings in soil science. These and other terms are defined in the Glossary.

Engineering classification systems

Two systems of classifying soils are in general use among engineers and are used in this report. It is assumed that persons using this report are familiar with these systems or have available reference material on them.

Therefore, detailed information on the systems is not included here.

Most highway engineers classify soil materials in accordance with the system approved by the American Association of State Highway Officials (AASHO) (*2*). In this system, soil materials are classified in seven principal groups. The groups range from A–1, consisting of gravelly soils of high bearing capacity, to A–7, which is made up of clay soils having low strength when wet. With each group, the relative engineering value of the material is indicated by a group index number. The group index for the soil groups A–1 and A–3 is 0. The poorest soils in group A–2 have a group index number of 4; in group A–4, 8; in group A–5, 12; in group A–6, 16; and in group A–7, 20. The group index number is shown in parentheses, after the soil group symbol, in the next to last column of table 6.

Many engineers prefer to use the Unified soil classification system (*20*). In this system, which is based on identifying soils according to their texture and plasticity, the soils are grouped according to their performance as engineering construction materials. The system establishes 15 soil classes which are put into three groups: (1) coarse-grained soils (8 classes), (2) fine-grained soils (6 classes), and (3) highly organic soils (1 class). These classes, designated by pairs of letters, range from GW to Pt. Class GW consists of well-graded gravel or gravel-sand mixtures that contain little or no fines. Class Pt consists of peat and other highly organic soils. Dual classification symbols are provided for soils that have characteristics of two classes.

In the Unified system, the soils of this county are classified only in the GM, SP, SM, SC, ML, CL, and CH classes. The system provides for a simple field method and a laboratory method for determining the grain size and plastic properties of the soils. Both methods are based on gradation and plasticity and vary only in degree of accuracy. The laboratory method used mechanical analyses, liquid limit data, and plasticity indexes for an exact classification. A plasticity chart on which the liquid limit and the plasticity index are plotted is used for a more accurate classification of the fine-grained soils. The classification of the tested soils according to the Unified system is given in the last column of table 6.

Engineering test data

To be able to make the best use of the soil map and the soil survey report, the engineer should know the physical properties of the soil materials and the condition of the soil in place. After testing the soil materials and observing the behavior of soil in engineering structures and foundations, the engineer can develop designs that are suited to the soils shown on the map.

Table 6 gives engineering test data for samples of six different soil types from 14 sites. These samples were taken and tested according to standard procedures of the American Association of State Highway Officials. The tests were by the Bureau of Public Roads and by the Division of Materials and Tests, Nebraska Department of Roads. Samples tested by the Bureau of Public Roads were obtained by the Soil Conservation Service in soil surveys. The sample tested by the Nebraska Department of Roads was taken by the department.

In describing each soil horizon, the Nebraska Department of Roads uses terminology that differs from that of the Soil Conservation Service. The SCS designates horizons as A, B, C, and R, which are defined in the Glossary. The Department of Roads describes the horizons as the upper layer, the middle layer, and the lower layer, or parent material. The upper layer is approximately equivalent to the A horizon, the middle layer to the B horizon, and the lower layer or parent material to the C horizon.

The soils listed in table 6 were sampled at one or more locations. The test data for a soil sampled at only one location indicates the engineering characteristics of the soil at that specific location. It must be recognized that there may be variations in the physical test characteristics of this soil at other locations in the county. Even for those soils sampled in more than one location, the test data probably do not show the maximum range in characteristics of materials that may occur.

Table 6 gives compaction (moisture-density) data for the soils tested. If a soil material is compacted at successively higher moisture content, assuming that the compactive effort remains constant, the density of the compacted material increases until the *optimum moisture content* is reached, but after that the density decreases with an increase in moisture. The highest dry density obtained in the compaction test is called the *maximum dry density.* Moisture-density data are important in earthwork because, as a rule, the soil is most stable if it is compacted to about the maximum dry density when it is at approximately the optimum moisture content.

The classification in the last two columns of table 6 are based on data obtained from mechanical analyses and tests to determine liquid limits and plastic limits. The mechanical analyses were made by the combined sieve and hydrometer methods.

The tests for liquid limit and plastic limit measure the effect of water on the consistency of the soil material. As moisture is added to a very dry, clayey soil, the material changes from a semisolid to a plastic state. If more water is added, the material changes from a plastic to a liquid state. The *plastic limit* is the moisture content, expressed as a percentage of the oven-dry weight of the soil, at which the material passes from semisolid to a plastic state. The *liquid limit* is the moisture content at which the material passes from a plastic to a liquid state. Between the liquid limit and the plastic limit is a numerical difference called the *plasticity index.* This index expresses the range of moisture content within which a soil acts as a plastic material. Some silty and sandy soils are nonplastic; that is, they are not plastic at any moisture content.

Engineering descriptions and interpretations of soils

Engineering information about each soil in the county is given in tables 7 and 8. For more information on the soils, it is necessary to refer to other parts of the report, particularly to the section "Descriptions of Soils." Information on the geology of Deuel County is given under Parent Material in the section "Formation and Classification of the Soils."

ENGINEERING DESCRIPTIONS OF SOILS

Table 7 gives a brief description of the soils in the county and an estimate of their physical properties. The

TABLE 6.—*Engineering test data*[1] *for*

Soil name and location	Parent material	Bureau of Public Roads report No.	Depth	Horizon	Moisture-density[2]: Maximum dry density	Moisture-density[2]: Optimum moisture
			Inches		*Lb. per cu. ft.*	*Percent*
Altvan loam:						
500 feet N. and 100 feet E. of the SW. cor., sec. 29, T. 16 N., R. 57 W.[5]	Eolian silt over sand and gravel.	S32380	0–6	Alp	118	13
		S32381	15–24	B2	104	19
		S32382	30–48	IIC	124	10
Dawes loam:						
0.2 mile E. and 180 feet S. of NW. cor., sec. 4, T. 12 N., R. 45 W.	Loess over gravel.	S34433	0–6	Alp	114	13
		S34434	8–16	B2	93	25
		S34435	24–32	C1	107	18
0.2 mile S. and 180 feet W. of NE. cor., sec. 6, T. 12 N., R. 45 W.	Loess over gravel.	S34436	0–5	Alp	109	15
		S34437	7–14	B2	89	29
		S34438	17–25	C1	101	21
200 feet W. and 200 feet N. of SE. cor. of NE¼, sec. 11, T. 12 N., R. 46 W.	Loess over gravel.	S34442	0–5	Ap	115	14
		S34443	8–15	B2	101	21
		S34444	18–44	C1	105	19
0.2 mile E. and 50 feet S. of NW. cor., sec. 4, T. 12 N., R. 45 W.	Loess over gravel.	S34439	0–5	Ap	115	13
		S34440	5–14	B2	100	21
		S34441	21–33	Cca	111	16
Goshen silt loam:						
0.2 mile N. and 100 feet W. of SE. cor., sec. 15, T. 14 N., R. 42 W.	Loess and alluvium.	S34451	0–6	Alp	102	18
		S34452	26–40	Albl	104	19
		S34453	48–60	Bb	108	18
450 feet E. and 180 feet N. of SW. cor., sec. 21, T. 14 N., R. 42 W.	Loess and alluvium.	S34445	0–5	Alp	106	16
		S34446	13–24	B21	110	16
		S34447	37–47	Cca	111	16
0.15 mile N. and 130 feet E. of SW. cor., sec. 36, T. 14 N., R. 45 W.	Loess and alluvium.	S34448	0–7	Alp	106	16
		S34449	14–21	B21	107	18
		S34450	36–47	Cca	108	18
150 feet N. of SW. cor. of SE¼, sec. 27, T. 14 N., R. 45 W.	Loess and alluvium.	S34454	0–6	Alp	105	18
		S34455	12–28	B2	110	16
		S34456	36–50	Cca	110	16
Keith silt loam:						
225 feet S. and 135 feet E. of NW. cor. of SW¼, sec. 7, T. 14 N., R. 41 W.	Loess.	S34457	0–6	Alp	108	17
		S34458	6–12	B21	106	18
		S34459	24–34	Cca	110	17
0.15 mile S. and 160 feet E. of NW. cor. of SW¼, sec. 2, T. 14 N., R. 42 W.	Loess.	S34460	0–6	Alp	109	16
		S34461	6–11	B21	107	18
		S34462	23–35	Cca	109	17
0.1 mile S. and 80 feet W. of NE. cor. of SE¼, sec. 13, T. 14 N., R. 42 W.	Loess.	S34466	0–6	Alp	106	17
		S34467	6–12	B2	107	18
		S34468	12–36	Cca	108	17
Richfield silt loam:						
600 feet W. and 135 feet S. of NE. cor. of NW¼, sec. 28, T. 14 N., R. 45 W.	Loess.	S34463	0–8	Alp	109	16
		S34464	13–20	B21	101	21
		S34465	30–48	Cca	107	18
Valentine fine sand, rolling:						
2,195 feet SE. from the N. sec. line, sec. 4, T. 21 N., R. 32 W., on State Hwy. 97.[7]	Eolian sand.	S59-5308	0–10	([8])	--------	--------
		S59-5335	10–108	([9])	--------	--------
		S59-5336	108–228	([9])	--------	--------

[1] Tests performed by the Department of Commerce, Bureau of Public Roads, in accordance with standard procedures of the American Association of State Highway Officials (AASHO) (*2*).

[2] Based on AASHO Designation: T 99–57, Method A (*2*).

[3] Mechanical analyses according to the American Association of State Highway Officials Designation: T 88–57 (*2*). Results by this procedure frequently may differ somewhat from results that would have been obtained by the soil survey procedure of the Soil Conservation Service (SCS). In the AASHO procedure, the fine material is analyzed by the hydrometer method, and the various grain-size fractions are calculated on the basis of all the material, including that coarser than 2 millimeters in diameter. In the SCS soil survey procedure, the fine material is analyzed by the pipette method and the material coarser than 2 millimeters in diameter is excluded from calculations of grain-size fractions. The mechanical analyses used in this table are not suitable for use in naming textural classes for soils.

samples taken from 14 soil profiles

Mechanical analysis [3]											Liquid limit	Plasticity index	Classification	
Percentage passing sieve—							Percentage smaller than—						AASHO	Unified [4]
¾ in.	⅜ in.	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 60 (0.25 mm.)	No. 200 (0.074 mm.)	0.05 mm.	0.02 mm.	0.005 mm.	0.002 mm.				
100	99	96	87	66	60	48	40	25	15	11	26	5	A-4(3)	SM-SC.
------	100	99	97	89	85	78	72	48	33	29	47	23	A-7-6(15)	CL.
100	99	95	81	30	20	11	10	7	6	6	[6]	[6]	A-1-b(0)	SW-SM.
------	100	98	93	83	79	72	60	36	19	13	26	6	A-4(7)	ML-CL.
------	------	------	100	98	97	94	87	63	47	41	52	26	A-7-6(17)	CH.
------	------	------	100	99	99	93	78	39	16	11	30	6	A-4(8)	ML-CL.
100	99	98	94	88	85	78	68	40	20	13	27	6	A-4(8)	ML-CL.
------	------	------	100	99	98	95	89	67	51	46	59	29	A-7-5(20)	MH-CH
------	------	------	------	------	100	97	86	52	29	21	35	11	A-6(8)	ML-CL.
100	98	95	89	80	76	66	57	36	21	18	28	8	A-4(6)	CL.
------	100	99	97	93	91	84	78	55	38	33	44	20	A-7-6(13)	CL.
------	------	------	100	99	98	94	81	46	24	17	32	8	A-4(8)	ML-CL.
100	99	97	93	83	79	73	63	35	18	13	25	6	A-4(8)	ML-CL.
------	100	99	98	94	93	89	82	57	38	35	47	22	A-7-6(14)	CL.
100	99	97	94	89	87	80	64	34	15	10	28	5	A-4(8)	ML-CL.
------	------	------	------	100	99	85	73	43	24	18	31	7	A-4(8)	ML-CL.
------	------	------	------	------	100	89	78	50	29	22	34	12	A-6(9)	ML-CL.
------	------	------	100	99	98	82	70	44	28	22	31	10	A-4(8)	ML-CL.
------	------	------	100	99	97	83	70	41	24	17	28	6	A-4(8)	ML-CL.
------	------	------	100	99	97	79	67	43	28	24	33	14	A-6(10)	CL.
------	------	------	100	99	97	80	66	40	24	17	26	6	A-4(8)	ML-CL.
------	------	------	100	99	98	86	71	43	26	19	29	7	A-4(8)	ML-CL.
------	------	------	------	100	99	91	76	50	31	25	32	10	A-4(8)	ML-CL.
------	------	------	------	------	100	92	76	42	22	16	30	7	A-4(8)	ML-CL.
------	------	------	100	97	94	83	70	43	24	18	32	7	A-4(8)	ML-CL.
------	------	------	100	95	91	77	65	42	27	21	34	14	A-6(10)	CL.
------	------	------	100	97	95	83	69	39	22	16	29	7	A-4(8)	ML-CL.
------	------	------	------	------	100	91	72	40	25	20	30	8	A-4(8)	ML-CL.
------	------	------	------	------	100	90	76	45	30	26	38	17	A-6(11)	CL.
------	------	------	------	------	100	90	74	43	24	17	30	8	A-4(8)	ML-CL.
------	------	------	------	------	100	88	70	39	23	19	28	6	A-4(8)	ML-CL.
------	------	------	------	------	100	89	70	42	26	21	34	11	A-6(8)	ML-CL.
------	------	------	------	------	100	88	70	38	20	15	30	6	A-4(8)	ML-CL.
------	------	------	------	------	100	89	68	37	20	16	30	5	A-4(8)	ML.
------	------	------	------	------	100	88	68	39	25	21	35	12	A-6(9)	ML-CL.
------	------	------	------	------	100	90	68	37	21	13	30	7	A-4(8)	ML-CL.
------	------	------	100	95	93	84	69	40	20	15	28	5	A-4(8)	ML-CL.
------	------	------	100	98	97	91	80	54	35	30	41	16	A-7-6(11)	ML-CL.
------	------	------	100	99	99	92	75	41	21	14	30	5	A-4(8)	ML.
------	------	------	100	99	94	4	2	------	2	------	[6]	[6]	A-3(0)	SW.
------	------	------	100	99	96	3	2	------	2	------	[6]	[6]	A-3(0)	SW.
------	------	------	100	99	95	4	2	------	2	------	[6]	[6]	A-3(0)	SW.

[4] Based on the Unified soil classification system (*20*). SCS and Bureau of Public Roads have agreed to consider that all soils having plasticity indexes within two points of the A-line are to be given a borderline classification. Examples of borderline classifications obtained by this use are SM-SC, SW-SM, and ML-CL.

[5] Sample taken in Kimball County.

[6] Nonplastic.

[7] Sample taken in Hooker County, and tests performed by Division of Materials and Tests, Nebraska Department of Roads.

[8] Upper layer.

[9] Parent material.

730-992—65——3

soil test data in table 6, together with information given in the rest of the report and other facts known about the individual soils of the county, were used as a basis for preparing the soil engineering data in table 7. This information also was used in classifying the soils in accordance with the Unified and AASHO systems.

The rate of surface runoff reflects differences in topography as well as in soil characteristics. Most soils of the

TABLE 7.—*Description of the soils and*

[Characteristics of complexes are variable and are not listed. See

Map symbol	Soil	Description of soil and site					
		Position	Underlying materials [1]	Surface runoff	Depth to water table	Depth to bedrock or to sand and gravel	Depth from surface
					Feet	*Feet*	*Inches*
3AB 3AB2	Altvan loam, 3 to 5 percent slopes.[2] Altvan loam, 3 to 5 percent slopes, eroded.	Upland.	Stratified sands and gravel.	Moderate.	(3)	1. 5 to 3	0–7 7–34 34–60
ACC ACC2	Altvan-Chappell complex, 5 to 9 percent slopes.[2] [4] Altvan-Chappell complex, 5 to 9 percent slopes, eroded.	Upland.	Stratified sands and gravel.	Moderate.	(3)	1. 5 to 3	-------
An AnB AnC	Anselmo fine sandy loam, 0 to 1 percent slopes. Anselmo fine sandy loam, 1 to 5 percent slopes.[1] Anselmo fine sandy loam, 5 to 9 percent slopes.	Upland.	Silty sands.	Slow to moderate.	(3)	(5)	0–10 10–30 30–60
AoBW AoCW	Anselmo loamy fine sand, 0 to 5 percent slopes.[1] Anselmo loamy fine sand, 5 to 9 percent slopes.	Upland.	Silty sands.	Slow to very slow.	(3)	(5)	0–6 6–48 48–60
Bf	Bayard fine sandy loam, 0 to 1 percent slopes.	Terrace.	Stratified sands and silts.	Slow.	10 to 20	(5)	0–23 23–50 50–60
BH BHA	Bridgeport and Havre loams, 0 to 1 percent slopes.[2] Bridgeport and Havre loams, 1 to 3 percent slopes.	Terrace.	Stratified silts and sands.	Slow.	10 to 20	(5)	0–14 14–35 35–60
Bw	Bayard loam, 0 to 1 percent slopes.	Bottom land.	Stratified sands and silts.	Slow.	6 to 10	8 to 10	0–9 9–45
CD	Canyon complex.	Upland.	Limy sandstone.	Moderate to very rapid.	(3)	1 to 2	0–6 6–11
ChA	Chappell sandy loam, 0 to 3 percent slopes.	Upland and terrace.	Stratified sands and gravel.	Slow.	15 to 30	1.5 to 3	0–11 11–31 31–40
CUB CUD	Colby-Ulysses silt loams, 3 to 5 percent slopes. Colby-Ulysses silt loams, 5 to 15 percent slopes.[2] [6]	Upland.	Silts.	Moderate to rapid.	(3)	(5)	0–11 11–36
Cy CyA	Cheyenne loam, 0 to 1 percent slopes. Cheyenne loam, 1 to 3 percent slopes. [2]	Terrace.	Stratified sands and gravel.	Slow to moderate.	15 to 30	2 to 4	0–20 20–32 32–45
DCD	Dix-Chappell loams, 9 to 15 percent slopes.[7]	Upland.	Stratified sands and gravel.	Moderate to rapid.	(3)	1 to 2	0–7 7–20 20–30

See footnotes at end of table.

county have slow or medium runoff because their surface layer is medium textured or moderately coarse textured and infiltration of water is generally moderate or moderately rapid. Surface runoff is slow on all nearly level or very gently sloping soils and also on those soils that have a coarse-textured surface layer. Runoff is rapid, however, on the Altvan, Canyon, Colby, and Ulysses soils on steeper slopes.

estimates of their physical properties

characteristics given for the soils that make up the complex]

Classification			Percentage passing sieve—			Permeability	Available water capacity	Shrink-swell potential
USDA	Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)			
						Inches per hour	*Inches per inch of soil*	
Loam	ML	A-4	95-100	85-95	50-60	0.8 - 2.5	0.16	Moderate.
Sandy clay loam	SC	A-2, A-4, A-7	95-100	90-100	20-50	0.2 - 0.8	0.17	Low to moderate.
Sand and gravel	SP to SC	A-1	75-90	50-80	3-15	10 +	0.06	None.
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Fine sandy loam	SM	A-4	----------	100	40-50	2.5 - 5.0	0.15	Low.
Fine sandy loam	SM	A-4	----------	100	40-50	2.5 - 5.0	0.15	Low.
Fine sandy loam	SM	A-4	----------	100	40-50	2.5 - 5.0	0.15	Low.
Loamy fine sand	SM	A-2	----------	100	20-35	5.0 -10.0	0.10	None.
Fine sandy loam	SM	A-4	----------	100	35-45	2.5 - 5.0	0.15	None to low.
Loamy fine sand	SM	A-2	----------	100	20-35	5.0 -10.0	0.10	None.
Fine sandy loam	SM	A-4	95-100	90-100	40-50	2.5 - 5.0	0.15	None to low.
Fine sandy loam	SM	A-4	95-100	90-100	40-50	2.5 - 5.0	0.15	None to low.
Very fine sandy loam	ML	A-4	----------	100	50-60	0.8 - 2.5	0.16	Low.
Very fine sandy loam	ML	A-4	----------	100	50-60	0.8 - 2.5	0.16	Low.
Very fine sandy loam	SM or ML	A-4	----------	100	45-55	0.8 - 2.5	0.16	Low.
Fine sandy loam	SM	A-4	95-100	90-95	35-50	2.5 - 5.0	0.15	None.
Loam	ML	A-4	95-100	90-95	65-80	0.8 - 2.5	0.16	Low.
Fine sandy loam	SM or SC	A-2 or A-4	95-100	85-95	25-45	2.5 - 5.0	0.15	None.
Gravelly loam	SM or GM	A-1 or A-2	60-80	50-75	20-35	0.8 - 2.5	0.16	Low.
Gravelly loam	GM or SM	A-1 or A-2	40-60	20-50	5-20	0.8 - 2.5	0.15	Low.
Sandy loam	SM	A-2 or A-4	95-100	90-95	30-50	2.5 - 5.0	0.15	None.
Gravelly sandy loam	SM	A-2	70-90	40-70	30-50	2.5 - 5.0	0.12	None.
Sand and gravel	SP to SM	A-1	75-90	35-50	5-15	10+	0.06	None.
Silt loam	ML	A-4	----------	100	75-90	0.8 - 2.5	0.16	Low.
Very fine sandy loam	ML	A-4	----------	100	60-75	0.8 - 2.5	0.16	Low.
Loam	ML	A-4	95-100	90-95	50-60	0.8 - 2.5	0.16	Low.
Sandy loam	SM	A-2 or A-4	85-95	70-90	20-50	2.5 - 5.0	0.15	None.
Sand and gravel	SP to SM	A-1	75-90	35-50	5-20	10+	0.06	None.
Sandy loam to loam	SM to ML	A-4	85-95	80-90	40-60	0.8 - 2.5	0.16	Low.
Gravelly loam	SM or GM	A-1 or A-2	80-95	55-80	15-30	2.5 - 5.0	0.14	None to low.
Sand and gravel	SP	A-1	50-75	35-50	0-5	10+	0.06	None.

TABLE 7.—*Description of the soils and*

Map symbol	Soil	Description of soil and site: Position	Underlying materials[1]	Surface runoff	Depth to water table	Depth to bedrock or to sand and gravel	Depth from surface
					Feet	*Feet*	*Inches*
DK DKA	Dawes-Keith loams, 0 to 1 percent slopes.[2] [8] Dawes-Keith loams, 1 to 3 percent slopes.	Upland.	Stratified sands and gravel.	Slow.	(3)	3 to 4	0–7 7–19 19–36 36–46
Du	Dunday loamy fine sand.	Upland.	Sands.	Slow.	(3)	(5)	0–8 8–60
DxD DxE	Dix complex, 5 to 20 percent slopes.[2] Dix complex, 20 to 30 percent slopes.	Upland.	Stratified sands and gravel.	Slow to rapid.	(3)	0.5 to 1.5	0–5 5–18 18–24
Gf	Goshen fine sandy loam, 0 to 3 percent slopes.	Upland.	Silts.	Slow.	(3)	(5)	0–6 6–21 21–46 46–60
Gh GhA	Goshen silt loam, 0 to 1 percent slopes.[2] Goshen silt loam, 1 to 3 percent slopes.	Upland.	Silts.	Slow.	(3)	(5)	0–17 17–48 48–60
KeB KeB2 KeC KeC2	Keith silt loam, 3 to 5 percent slopes.[2] Keith silt loam, 3 to 5 percent slopes, eroded. Keith silt loam, 5 to 9 percent slopes. Keith silt loam, 5 to 9 percent slopes, eroded.	Upland.	Silts.	Slow to moderate.	(3)	(5)	0–11 11–26 26–40
KK	Keith-Kuma silt loams, 0 to 1 percent slopes.	Upland.	Silts.	Slow.	(3)	(5)	0–11 11–33 33–54
KR KRA	Keith-Richfield silt loams, 0 to 1 percent slopes. Keith-Richfield silt loams, 1 to 3 percent slopes.[2] [9]	Upland.	Silts.	Slow to moderate.	(3)	(5)	0–6 6–18 18–40
KT KTB KTB2 KTC2	Keith and Tripp fine sandy loams, 0 to 3 percent slopes.[2] Keith and Tripp fine sandy loams, 3 to 5 percent slopes. Keith and Tripp fine sandy loams, 3 to 5 percent slopes, eroded. Keith and Tripp fine sandy loams, 5 to 9 percent slopes, eroded.	Upland.	Silts.	Slow to moderate.	(3)	(5)	0–10 10–26 26–40
Lc	Las Animas fine sandy loam.	Bottom land.	Stratified sands and gravel.	Slow.	2 to 4	1.5 to 3	0–7 7–30 30–40
LS	Laurel soils.	Bottom land.	Stratified sands and gravel.	Slow.	2 to 4	4 to 6	0–12 12–45 45–60
Lt	Las loam.	Bottom land.	Stratified sands and gravel.	Slow.	2.5 to 4	2.5 to 4	0–17 17–30 30–40
Lw	Las Animas loamy sand.	Bottom land.	Stratified sands and gravel.	Slow to very slow.	2 to 5	1.5 to 3	0–21 21–29 29–50

See footnotes at end of table.

estimates of their physical properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Shrink-swell potential
USDA	Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)	*Inches per hour*	*Inches per inch of soil*	
Loam	ML	A-4	95–100	85–95	65–80	0.8 – 2.5	0.16	Low.
Silty clay	CH	A-7	95–100	95–100	85–95	0.05– 0.2	0.18	High.
Silt loam	ML	A-4 or A-6	95–100	95–100	85–95	0.8 – 2.5	0.16	Low.
Fine and medium gravel.	SP	A-1	75–90	35–50	0–5	10+	0.06	None.
Loamy fine sand	SM	A-2 or A-4		100	15–40	5.0 –10.0	0.10	None.
Fine sand	SM or SP-SM	A-2 or A-3		100	5–20	10+	0.06	None.
Gravelly sandy loam	SM	A-1 or A-2	70–90	40–70	5–15	2.5 – 5.0	0.12	None.
Gravelly loam	SM	A-1	75–95	50–75	10–25	2.5 – 5.0	0.14	Low.
Sand and gravel	SP	A-1	70–90	30–50	0–5	10+	0.06	None.
Fine sandy loam	SM or SC	A-4	95–100	90–100	40–50	2.5 – 5.0	0.15	None to low.
Loam	ML	A-4	100	95–100	50–60	0.8 – 2.5	0.16	Low.
Clay loam	CL or CH	A-6 or A-7	100	95–100	70–90	0.2 – 0.8	0.17	Moderate to high.
Silt loam	ML	A-4 or A-6	100	95–100	80–95	0.8 – 2.5	0.16	Low to moderate.
Silt loam	ML	A-4 or A-6	100	95–100	80–95	0.8 – 2.5	0.16	Low to moderate.
Silty clay loam	CL	A-6 or A-7	100	95–100	85–95	0.2 – 0.8	0.17	Moderate.
Silt loam	ML	A-4 or A-6	100	95–100	75–90	0.8 – 2.5	0.16	Low.
Silt loam	ML	A-4 or A-6		100	85–95	0.8 – 2.5	0.16	Low.
Silty clay loam	CL	A-7 or A-6		100	85–95	0.2 – 0.8	0.17	Moderate.
Silt loam	ML	A-4 or A-6		100	85–95	0.8 – 2.5	0.16	Low.
Silt loam	ML	A-4 or A-6		100	85–95	0.8 – 2.5	0.16	Low.
Silty clay loam	CL	A-6 or A-7		100	90–95	0.2 – 0.8	0.17	Moderate.
Silt loam	ML	A-4 or A-6		100	85–95	0.8 – 2.5	0.16	Low.
Silt loam	ML or CL	A-4 or A-6		100	85–95	0. 8 – 2. 5	0. 16	Low.
Silty clay loam	CL	A-6 or A-7		100	90–95	0. 2 – 0. 8	0. 17	Moderate.
Silt loam	ML or CL	A-4 or A-6		100	85–95	0. 8 – 2. 5	0. 16	Low.
Fine sandy loam	SM	A-4	95–100	90–100	40–50	2. 5 – 5. 0	0. 15	None to low.
Clay loam	CL	A-6 or A-7		95–100	70–90	0. 2 – 0. 8	0. 17	Moderate.
Very fine sandy loam	ML	A-4		100	60–75	0. 8 – 2. 5	0. 16	Low.
Fine sandy loam	SM	A-4	95–100	90–100	35–50	2. 5 – 5. 0	0. 15	None to low.
Gravelly loamy sand	SP or SM	A-1 or A-2	80–90	70–80	10–20	5. 0 –10. 0	0. 10	None.
Sand and gravel	SP	A-1	75–90	35–50	0–5	10+	0. 06	None.
Loam	ML	A-4	95–100	95–100	50–60	0. 8 – 2. 5	0. 16	Low.
Clay loam	CL	A-6	95–100	95–100	60–85	0. 2 – 0. 8	0. 17	Moderate.
Sand and gravel	SP or SP-SM	A-1	75–90	35–50	0–10	10+	0. 06	None.
Loam	ML	A-4	95–100	95–100	50–60	0. 8 – 2. 5	0. 16	Low.
Clay loam	CL	A-6 or A-7	95–100	95–100	65–85	0. 2 – 0. 8	0. 17	Moderate.
Sand and gravel	SP	A-1	75–90	35–50	0–5	10+	0. 06	None.
Loamy sand	SM	A-1 or A-2	95–100	95–100	10–25	5. 0 –10. 0	0. 10	None.
Sandy loam	SM	A-2 or A-4	95–100	95–100	30–45	2. 5 – 5. 0	0. 15	None to low.
Stratified sand	SP to SM	A-1 or A-2	75–90	35–50	0–15	10+	0. 06	None.

TABLE 7.—*Description of the soils and*

Map symbol	Soil	Description of soil and site					
		Position	Underlying materials [1]	Surface runoff	Depth to water table	Depth to bedrock or to sand and gravel	Depth from surface
					Feet	*Feet*	*Inches*
Na	Nunn silt loam.	Low terrace.	Silts.	Slow.	8 to 15	(5)	0–7 7–42 42–60
NS	Nunn-Slickspots complex.						
RbA RbB RbB2	Rosebud loam, 0 to 3 percent slopes. Rosebud loam, 3 to 5 percent slopes. Rosebud loam, 3 to 5 percent slopes, eroded.[2]	Upland.	Limy sandstone.	Moderate.	(3)	2 to 4	0–6 6–14 14–36
RCC RCC2 RCD	Rosebud-Canyon complex, 5 to 9 percent slopes. Rosebud-Canyon complex, 5 to 9 percent slopes, eroded. Rosebud-Canyon complex, 9 to 15 percent slopes.						
RdB RdB2 RdC RdC2	Rosebud fine sandy loam, 3 to 5 percent slopes. Rosebud fine sandy loam, 3 to 5 percent slopes, eroded. Rosebud fine sandy loam, 5 to 9 percent slopes. Rosebud fine sandy loam, 5 to 9 percent slopes, eroded.[2]	Upland.	Limy sandstone.	Moderate.	(3)	3 to 6	0–10 10–32 32–60
Sc	Scott silty clay loam.	Upland depression.	Silts.	Ponded.	(3)	(5)	0–8 8–38 38–48
Ss	Slickspots.	High bottom land.	Silts.	Slow.	4 to 8	4 to 8	0–7 7–28 28–45
Sx	Sandy alluvial land.	Bottom land.	Stratified sands and gravel.	Slow.	(3)	0 to .5	0–4 4–26
TK TKA	Tripp-Keith silt loams, 0 to 1 percent slopes.[2] [10] Tripp-Keith silt loams, 1 to 3 percent slopes.	Terrace.	Silts.	Slow to moderate.	15 to 30	(5)	0–14 14–36 36–50
VaC VaD	Valentine fine sand, rolling.[2] Valentine fine sand, hilly.	Upland.	Sands.	Slow.	(3)	(5)	0–5 5–60
Wm	Wann loam.	Bottom land.	Stratified sands and gravel.	Slow.	2 to 3.5	2.5 to 3.5	0–17 17–33 33–50
Wx	Wet alluvial land.	Bottom land.	Stratified sands and gravel.	Slow.	1 to 3	0 to 1	0–60

[1] Materials that underlie the soil generally at a depth between 4 and 10 feet.

[2] Classification and properties are those of this phase. Soils in this group are nearly uniform in properties listed except for runoff and, as indicated by the soil name, slope, degree of erosion, or alkalinity (only in very small areas). The range given for runoff covers all the slope and erosion phases listed.

[3] Extremely deep water table.

[4] Data are for the Chappell soils. (See descriptions of Altvan and Chappell soils.)

[5] Bedrock or sand and gravel occur below the normal depth of sampling.

estimates of their physical properties—Continued

Classification			Percentage passing sieve—			Permeability	Available water capacity	Shrink-swell potential
USDA	Unified	AASHO	No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 200 (0.074 mm.)			
						Inches per hour	*Inches per inch of soil*	
Silt loam	ML	A-4		100	75-90	0.8 - 2.5	0.16	Low.
Silty clay loam	CL	A-7		100	80-95	0.2 - 0.8	0.17	Moderate.
Silt loam	ML	A-4		100	75-90	0.8 - 2.5	0.16	Low.
Loam	ML or CL	A-4	95-100	90-100	50-60	0.8 - 2.5	0.16	Low.
Clay loam	CL	A-6 or A-7	95-100	95-100	65-85	0.2 - 0.8	0.17	Moderate.
Loam	ML	A-4	95-100	90-100	50-65	0.8 - 2.5	0.16	Low.
Fine sandy loam	SM	A-4	95-100	90-100	35-50	2.5 - 5.0	0.15	None to low.
Sandy clay loam	CL	A-6 or A-7	95-100	90-100	60-80	0.2 - 0.8	0.17	Moderate.
Fine sand	SP-SM or SM	A-1 or A-2	100	95-100	5-20	10+	0.06	None.
Silty clay loam	CL	A-6 or A-7		100	85-95	0.2 - 0.8	0.17	Moderate.
Silty clay	CH	A-7		100	95-100	0.05- 0.2	0.18	High.
Loam	ML	A-4	100	95-100	50-60	0.8 - 2.5	0.16	Low.
Loam	ML or CL	A-4 or A-6		100	50-60	0.8 - 2.5	0.16	Low.
Silty clay to silty clay loam.	CL or CH	A-6 or A-7		100	80-100	0.05- 0.2	0.18-0.17	Moderate to high.
Stratified loamy material.	ML or CL	A-4 or A-6	95-100	85-100	50-90	0.2 - 0.8	0.16-0.17	Low to moderate.
Gravelly sandy loam	SM	A-2	75-90	50-70	15-35	2.5 - 5.0	0.15	None.
Sand and gravel	SP	A-1	50-85	15-50	0-5	10+	0.06	None.
Loam	ML or CL	A-4 or A-6		100	85-95	0.8 - 2.5	0.16	Low.
Loam	ML or CL	A-4 or A-6		100	85-95	0.8 - 2.5	0.16	Low.
Loam	ML or CL	A-4 or A-6		100	85-95	0.8 - 2.5	0.16	Low.
Fine sand	SM or SP-SM	A-2		100	10-20	10+	0.06	None.
Fine sand	SM or SP-SM	A-2 or A-3		100	5-20	10+	0.06	None
Loam	ML or CL	A-4	95-100	95-100	50-60	0.8 - 2.5	0.16	Low.
Fine sandy loam	SM	A-4	95-100	90-100	35-50	2.5 - 5.0	0.15	None
Sand and gravel	SP	A-1	75-90	33-50	0-5	10+	0.06	None.
Sand and gravel	GP, SP or SP-SM.	A-1	50-85	15-50	0-10	10+	0.06	None.

[6] Data are for the Colby soils. Classification and properties of the Ulysses soils are similar to those of the Keith soils. (See descriptions of Colby and Ulysses soils.)
[7] Data are for the Dix soils. (See descriptions of Dix and Chappell soils.)
[8] Data are for Dawes soils. (See descriptions of Dawes and Keith soils.)
[9] Data are for the Richfield soils. (See Keith silt loam for data on Keith soils.)
[10] Data are for the Tripp soils. (See Keith silt loam for data on Keith soils.)

TABLE 8.—*Engineering*

[Interpretations for some complexes are variable and are not listed.

Soil type and map symbols	Engineering classification		Suitability for—					
	Unified	AASHO	Topsoil	Sand	Sand and gravel	Subgrade of paved road	Subgrade of gravel road	Road fill
Altvan loam (3AB, 3AB2).	ML in surface soil; SC in subsoil; SP in substratum.	A-4 in surface soil; A-2, A-4, or A-7 in subsoil; A-1 in substratum.	Good	(1)	Good below 3 to 5 feet.	Fair to poor	Good to fair	Fair to poor
Altvan-Chappell complex (ACC, ACC2).								
Anselmo fine sandy loam (An, AnB, AnC).	SM in surface soil, subsoil, and substratum.	A-4 in surface soil, subsoil, and substratum.	Fair	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Anselmo loamy fine sand (AoBW, AoCW).	SM in surface soil, subsoil, and substratum.	A-2 in surface soil; A-4 in subsoil; A-2 in substratum.	Fair	(1)	(4)	Good to fair	Poor	Good to fair
Bayard fine sandy loam (Bf). Bayard loam (Bw).	SM in surface soil and subsoil; ML in substratum.	A-4 in surface soil, subsoil, and substratum.	Fair to good	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Bridgeport and Havre loams (BH, BHA).	ML in surface soil; SM or ML in subsoil; SM in substratum.	A-4 in surface soil, subsoil, and substratum.	Good	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Canyon complex (CD).	SM or GM in surface soil; GM or SM in subsoil and substratum.	A-1 or A-2 in surface soil and subsoil.	Poor	(1)	(4)	Good to fair	Poor	Good to fair
Chappell sandy loam (ChA).	SM in surface soil and subsoil; SP to SM in substratum.	A-2 or A-4 in surface soil; A-2 in subsoil; A-1 in substratum.	Fair	(1)	Good to fair below 3 to 5 feet.	Good to poor	Good to poor	Good to poor
Colby-Ulysses silt loams (CUB, CUD).	ML in surface soil, subsoil, and substratum.	A-4 in surface soil, subsoil, and substratum.	Fair to good	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Cheyenne loam (Cy, CyA).	ML in surface soil; SM in subsoil; SP or SM in substratum.	A-4 in surface soil; A-2 or A-4 in subsoil; A-1 in substratum.	Good	(1)	Good to fair below 3 to 5 feet.	Fair to poor	Good to fair	Fair to poor
Dix-Chappell loams (DCD).	SM to ML in surface soil; SM or GM in subsoil; SP in substratum.	A-4 in surface soil; A-1 or A-2 in subsoil; A-1 in substratum.	Poor to fair	(1)	Good below 2 feet.	Fair to poor	Good to fair	Fair to poor

See footnotes at end of table.

interpretations of soils

See interpretations for soils that make up the complex]

Soil features affecting—								
Highway location	Foundations	Dikes and levees	Low dams: Reservoir	Low dams: Embankment	Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Low susceptibility to frost action. Slopes erodible.	Good to fair bearing.	[2]	Very high seepage if substratum exposed.	Good to poor stability.	[2]	[3]	Moderately erodible. Alining terraces may be difficult because of irregular slopes.	[2].
Moderate to low susceptibility to frost action. Slopes highly erodible by wind and water.	Good to poor bearing. Piping may be severe.	[2]	Moderate seepage.	Good stability but needs close control. May require toe drains and flat slopes.	[2]	[3]	Highly erodible. Maintenance may be costly. Alining terraces may be difficult because of irregular slopes.	[2].
Generally not susceptible to frost action.	Good to poor bearing, dependent on density. Piping may be severe.	[2]	Moderate seepage.	Good stability but needs close control. Severe piping hazard. Slopes erodible.	[2]	[3]	Highly erodible. Maintenance may be costly. Alining terraces may be difficult because of irregular slopes.	[2].
Low susceptibility to frost action. Slopes erodible by wind.	Poor bearing. May be subject to severe piping	[2]	Seepage generally not a problem.	Good to poor stability. Close control may be required. Toe drains may be necessary.	[2]	Moderate water-holding capacity. Moderately rapid intake.	[2]	[2].
High susceptibility to frost action. Slopes highly erodible.	Good to poor bearing. Piping may be severe.	[2]	[2]	Good to poor stability. Close control required. May require toe drains.	[2]	High water-holding capacity.	Moderately erodible.	[2].
Low susceptibility to frost action. Many rock fragments at or near surface; limy sandstone. May be difficult to excavate.	Generally good bearing.	[2]	Seepage generally not a problem.	Good stability but needs close control. Severe piping will require toe drains.	Slow internal drainage; underlain by sandstone.	[2]	[2]	[2].
Low susceptibility to frost action. Slopes erodible by wind. Subject to overflow from higher lands in some places.	Good to fair bearing. May be subject to piping.	[2]	High seepage below subsoil.	Good stability. Close control may be required. May require toe drains.	[2]	Moderate to low water-holding capacity. Moderately rapid intake. Shallow root zone.	Highly erodible. Maintenance may be costly.	Highly erodible. Fertility low. Grassing waterways and maintaining them may be costly.
High susceptibility to frost action. Slopes highly erodible.	Poor bearing. May be subject to severe piping.	[2]	Seepage generally not a problem.	Good to poor stability. Slopes erodible.	[2]	[2]	Highly erodible. Maintenance may be costly.	[2].
Low susceptibility to frost action. Slopes highly erodible; subject to overflow from higher lands.	Good to fair bearing. May be subject to piping.	[2]	High seepage if substratum exposed.	Good to poor stability. Close control required. May require flat slopes and toe drains.	[2]	Moderate water-holding capacity. Shallow root zone.	Moderately erodible.	Moderately erodible. Fertility low in some places if subsoil is exposed.
Low to moderate susceptibility to frost action.	Good to fair bearing.	[2]	Very high seepage below a depth of 2 feet.	Generally good stability but needs close control. Toe drains may be required.	[2]	[2]	[2]	[2].

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TABLE 8.—*Engineering*

Soil type and map symbols	Engineering classification		Suitability for—					
	Unified	AASHO	Topsoil	Sand	Sand and gravel	Subgrade of paved road	Subgrade of gravel road	Road fill
Dawes-Keith loams (DK, DKA).[5]	ML in surface soil; CH in upper subsoil; ML in lower subsoil; SP in substratum.	A-4 in surface soil; A-7 in upper subsoil; A-4 or A-6 in lower subsoil; A-1 in substratum.	Good	(1)	Good below 4 to 6 feet.	Fair to poor	Good to fair	Fair to poor
Dunday loamy fine sand (Du).	SM in surface soil; SM or SP-SM in subsoil and substratum.	A-2 or A-4 in surface soil; A-1 or A-3 in subsoil and substratum.	Fair	Fair to good below 1 foot	(4)	Good to poor	Good to poor	Good to poor
Dix complex (DxD, DxE).	SM in surface soil and subsoil; SP in substratum.	A-1 or A-2 in surface soil; A-1 in subsoil and substratum.	Poor	(1)	Good below 2 feet.	Good to fair.	Poor	Good to fair
Goshen fine sandy loam (Gf).	SM or SC in surface soil; ML in upper subsoil; CL or CH in lower subsoil; ML in substratum.	A-4 in surface soil and upper subsoil; A-6 or A-7 in lower subsoil; A-4 or A-6 in substratum.	Fair to good	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Goshen silt loam (Gh,GhA).	ML in surface soil; CL in subsoil; ML in substratum.	A-4 or A-6 in surface soil; A-6 or A-7 in subsoil; A-4 or A-6 in substratum.	Good	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Keith silt loam (KeB, KeB2, KeC, KeC2).	ML in surface soil; CL in subsoil; ML in substratum.	A-4 or A-6 in surface soil; A-7 or A-6 in subsoil; A-4 or A-6 in substratum.	Good	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Keith-Kuma silt loams (KK).	ML in surface soil; CL in subsoil; ML in substratum.	A-4 or A-6 in surface soil; A-6 or A-7 in subsoil; A-4 or A-6 in substratum.	Good	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Keith-Richfield silt loams (KR, KRA).	ML or CL in surface soil; CL in subsoil; ML or CL in substratum.	A-4 or A-6 in surface soil; A-6 or A-7 in subsoil; A-4 or A-6 in substratum.	Good	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Keith and Tripp fine sandy loams (KT, KTB, KTB2, KTC2).	SM in surface soil; CL in subsoil; ML in substratum.	A-4 in surface soil; A-6 or A-7 in subsoil; A-4 in substratum.	Fair to good	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Las loam (Lt).	ML in surface soil; CL in subsoil; SP in substratum.	A-4 in surface soil; A-6 or A-7 in subsoil; A-1 in substratum.	Poor to fair	(1)	Good below 3 to 4 feet.	Fair to poor	Good to fair	Fair to poor

See footnotes at end of table.

interpretations of soils—Continued

Soil features affecting—								
Highway location	Foundations	Dikes and levees	Low dams: Reservoir	Low dams: Embankment	Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Moderate to high susceptibility to frost action. Slopes erodible.	Good to fair bearing, generally good below a depth of 4 feet.	(2)	High seepage below a depth of 3 feet.	Good to poor stability. Compaction difficult in subsoil.	Slow internal drainage to a depth of 3 feet.	(3)	(2)	(2).
Not susceptible to frost action. Slopes erodible by wind and water.	Good to fair bearing, dependent on density. May be subject to piping.	(2)	Moderate to high seepage.	Good stability. Close control may be required. Piping is a hazard. May require toe drains.	(2)	(2)	(2)	(2).
Not susceptible to frost action.	Good to fair bearing.	(2)	Very high seepage.	Good stability. Close control may be required. May require toe drains.	(2)	(2)	(2)	(2).
Low to moderate susceptibility to frost action.	Good to poor bearing. May be subject to severe piping below a depth of 4 feet.	(2)	Seepage generally not a problem.	Fair to poor stability. Close control required. Compaction may be difficult in subsoil.	(2)	(3)	(2)	Moderately erodible.
High susceptibility to frost action. Slopes erodible.	Poor bearing. Piping may be severe.	(2)	Seepage generally not a problem.	Good to poor stability. Slopes erodible. May require toe drains.	Moderately slow internal drainage.	(3)	(2)	Moderately erodible.
Very high susceptibility to frost action. Slopes highly erodible.	Poor bearing. Piping may be severe.	(2)	Seepage generally not a problem.	Good to poor stability. Close control necessary. Slopes erodible. May require toe drains.	Moderate to slow internal drainage.	(3)	Moderately erodible.	(2).
High susceptibility to frost action. Slopes highly erodible.	Poor bearing. May be subject to severe piping.	(2)	Seepage generally not a problem.	Good to poor stability. Close control necessary. May require toe drains. Slopes erodible.	Moderate to slow internal drainage.	High water-holding capacity. Slow intake. Adequate drainage must be provided.	(2)	(2).
Very high susceptibility to frost action. Slopes erodible.	Good to poor bearing.	(2)	Seepage generally not a problem.	Fair to poor stability. Slopes erodible. Compaction may be difficult.	Moderate to slow internal drainage.	(3)	Moderately erodible.	(2).
Low susceptibility to frost action. Slopes erodible.	Poor bearing. Piping may be severe.	(2)	Seepage generally not a problem.	Good to poor stability. Good control necessary. May require toe drains. Slopes erodible.	(2)	(3)	Moderately erodible.	(2).
Moderate susceptibility to frost action. Water table may rise to near surface. May require 4 feet of fill.	Good to fair bearing.	Slopes may be erodible.	(2)	Good to fair stability to a depth of 3 feet. Good stability below 3 feet.	Slow surface and internal drainage. High water table. Outlets may not be available.	Moderate to high water-holding capacity. Adequate drainage must be provided. Shallow root zone.	(2)	(2).

TABLE 8.—*Engineering*

Soil type and map symbols	Engineering classification		Suitability for—					
	Unified	AASHO	Topsoil	Sand	Sand and gravel	Subgrade of paved road	Subgrade of gravel road	Road fill
Las Animas fine sandy loam (Lc).	SM in surface soil; SP or SM in subsoil; SP in substratum.	A-4 in surface soil; A-1 or A-2 in subsoil; A-1 in substratum.	Fair	(1)	Good below 2 to 4 feet.	Fair to poor	Good to fair	Fair to poor
Las Animas loamy sand (Lw).	SM in surface soil and subsoil; SP to SM in substratum.	A-1 or A-2 in surface soil; A-2 or A-4 in subsoil; A-1 or A-2 in substratum.	Poor to fair	Fine sand; fair to depth of 2 feet.	Fair below 3 to 4 feet.	Good to fair	Poor	Good to fair
Laurel soils (LS).	ML in surface soil; CL in subsoil; SP or SP-SM in substratum.	A-4 in surface soil; A-6 in subsoil; A-1 in substratum.	Poor	(1)	Good to fair below 4 feet.	Fair to poor	Good to fair	Fair to poor
Nunn silt loam (Na).	ML in surface soil; CL in subsoil; ML in substratum.	A-4 in surface soil; A-7 in subsoil; A-4 in substratum.	Fair to good	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Nunn-Slickspots complex (NS).								
Rosebud fine sandy loam (RdB, RdB2, RdC, RdC2).	SM in surface soil; CL in subsoil; SP-SM or SM in substratum.	A-4 in surface soil; A-6 or A-7 in subsoil; A-1 in substratum.	Fair to good	Fine sand; fair below 3 feet.	(4)	Fair to poor	Good to fair	Fair to poor
Rosebud loam (RbA, RbB, RbB2).	ML or CL in surface soil; CL in subsoil; ML in substratum.	A-4 in surface soil; A-6 or A-7 in subsoil; A-4 in substratum.	Good	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Rosebud-Canyon complex (RCC, RCC2, RCD).								

See footnotes at end of table.

interpretations of soils—Continued

Soil features affecting—								
Highway location	Foundations	Dikes and levees	Low dams: Reservoir	Low dams: Embankment	Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Low susceptibility to frost action. Slopes erodible by wind. Water table may rise to near surface. May require 4 feet of fill. May be subject to overflow.	Good to fair bearing.	Flat slopes may be required. Moderate piping hazard.	(2)	Good stability but needs close control. May require toe drains.	Moderately slow surface drainage. High water table. Outlets may not be available.	Moderate to low water-holding capacity. Moderately rapid to rapid intake. Adequate drainage must be provided. Shallow root zone.	(2)	(2).
Not susceptible to frost action. Water table may rise to near surface. May require 4 feet of fill.	Good to poor bearing, dependent on density. May be subject to piping.	Flat slopes required. High piping hazard.	(2)	Good stability. Close control may be required. May require toe drains and flat slopes.	Moderately slow internal drainage. High water table. Outlets may not be available.	Low water-holding capacity. Moderately rapid to rapid intake. Adequate drainage must be provided. Shallow root zone.	(2)	(2).
Moderate susceptibility to frost action. Water table may rise to near surface. May require fill of 4 feet. May be subject to overflow.	Good to fair bearing. May be subject to piping.	Slopes may be erodible.	(2)	Good to poor stability.	Slow surface and internal drainage. Permanently high water table. Outlets may not be available.	High water-holding capacity. Slow release of moisture to plants. Slow intake. Adequate drainage must be provided. Best suited to alkali-tolerant grasses.	(2)	(2).
Low susceptibility to frost action. Slopes highly erodible.	Poor bearing. Subject to severe piping.	Slopes may be erodible.	Seepage generally not a problem.	Fair to poor stability. Close control necessary. Subject to piping and may require toe drains.	Moderately slow internal drainage.	High water-holding capacity.	(2)	(2).
Low to moderate susceptibility to frost action. Slopes highly erodible. A few fragments of sandstone rock occur in upper layers. Limy sandstone may be difficult to excavate, generally below 3 feet.	Good to fair bearing, depending on density. May be subject to piping.	(2)	Seepage generally not a problem.	Fair to good stability. May require toe drains.	(2)	(3)	Moderately to highly erodible. Maintenance may be costly. Alining terraces may be difficult because of irregular slopes.	(2).
Moderate to high susceptibility to frost action. Slopes highly erodible. Limy sandstone may be difficult to excavate, generally below 3 feet.	Poor bearing. Piping may be severe.	(2)	Seepage generally not a problem.	Poor to good stability. Close control required. Slopes erodible.	Moderate to slow internal drainage.	(3)	Moderately erodible. Alining terraces may be difficult because of irregular slopes.	(2).

TABLE 8.—*Engineering*

Soil type and map symbols	Engineering classification		Suitability for—					
	Unified	ASSHO	Topsoil	Sand	Sand and gravel	Subgrade of paved road	Subgrade of gravel road	Road fill
Scott silty clay loam (Sc).	CL in surface soil; CH in subsoil; ML in substratum.	A–6 or A–7 in surface soil; A–7 in subsoil; A–4 in substratum.	Poor	(1)	(4)	Poor	Good	Poor
Slickspots (Ss).	ML or CL in surface soil; CL or CH in subsoil; ML or CL in substratum.	A–4 or A–6 in surface soil; A–6 or A–7 in subsoil; A–4 or A–6 in substratum.	Very poor	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Sandy alluvial land (Sx).	SM in surface soil; SP in subsoil and substratum.	A–2 in surface soil; A–1 in subsoil and substratum.	Very poor	(1)	Good below 1 foot.	Good to fair	Poor	Good to fair
Tripp-Keith silt loams (TK, TKA).	ML or CL in surface soil, subsoil, and substratum.	A–4 or A–6 in surface soil, subsoil, and substratum.	Good	(1)	(4)	Fair to poor	Good to fair	Fair to poor
Valentine fine sand (VaC, VaD).	SM or SP–SM in surface soil, subsoil, and substratum.	A–2 in surface soil; A–2 or A–3 in subsoil and substratum.	Very poor	Fair to good below 1 foot.	(4)	Good to fair	Poor	Good to fair
Wann loam (Wm).	ML or CL in surface soil; SM in subsoil; SP in substratum.	A–4 in surface soil and subsoil; A–1 in substratum.	Fair to good	(1)	Good to fair below 3 to 5 feet.	Fair to poor	Good to fair	Fair to poor
Wet alluvial land (Wx).	GP, SP, or SP–SM in surface soil, subsoil, and substratum.	A–1 in surface soil, subsoil, and substratum.	Very poor	(1)	Good to fair at or near surface.	Good	Poor	Good

[1] Sand is generally not available.
[2] Because of position or topography, including slope, this practice or structure is generally not needed or applicable.
[3] Although the milder slopes are irrigable, irrigation of this soil is not presently feasible, because water is unavailable or is too costly.

interpretations of soils—Continued

Soil features affecting—								
Highway location	Foundations	Dikes and levees	Low dams		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
			Reservoir	Embankment				
High susceptibility to frost action. Subject to occasional to frequent ponding. Slopes highly erodible.	Poor bearing. May be subject to severe piping.	(2)	(2)	(2)	Very slow internal drainage. Ponding of water is common. Outlets are very difficult to locate.	(2)	(2)	(2).
Moderately susceptible to frost action. Slopes highly erodible.	Fair to poor bearing. May be subject to piping.	(2)	(2)	Good to poor stability. Slopes erodible.	Slow internal drainage, especially in subsoil. Outlets may not be available.	High water-holding capacity. Slow release of moisture to plants. Slow intake. Adequate drainage must be provided. Best suited to salt- and alkali-tolerant crops.	(2)	(2).
Low susceptibility to frost action. Subject to frequent overflow.	Generally good bearing below 2 feet.	May require flat slopes. Surface soil subject to piping.	Very high seepage.	Good stability. May require toe drains.	Subject to frequent overflow.	(2)	(2)	Highly erodible. Low in fertility. Constructing and maintaining waterways may be costly.
Low susceptibility to frost action. Slopes highly erodible.	Good to poor bearing.	(2)	Seepage generally not a problem.	Good to poor stability. Slopes erodible. May require toe drains and flattened slopes.	(2)	High water-holding capacity.	Erodbile	Erodible.
Not susceptible to frost action. Slopes very erodible by wind and water.	Good to poor bearing, depending on density and on confinement of sand. May be subject to piping.	(2)	Moderate to high seepage.	Good stability but needs close control. Severe piping hazard.	(2)	(2)	(2)	(2).
Moderate susceptibility to frost action. Water table may rise to near surface. May require 7 feet of fill. Slopes highly erodible.	Generally good bearing.	Slopes may be erodible. Subsoil may be subject to piping.	(2)	Poor to good stability, except generally good below 3 feet. May require toe drains.	Slow surface and internal drainage. High water table. Outlets may not be available.	Moderate water-holding capacity. Adequate drainage must be provided. Shallow root zone.	(2)	(2).
Not susceptible to frost action. Water table may rise to near surface. May require 4 feet of fill. Subject to frequent overflow.	Good to poor bearing, depending on density.	May require flat slopes. Moderate piping hazard.	Very high seepage.	Generally good stability. May require toe drains.	Very slow surface and internal drainage. Water table near surface. Subject to frequent overflow. Outlets very difficult to locate.	(2)	(2)	(2).

[4] Sand and gravel are generally not available.
[5] Interpretations are for the Dawes soils.

The estimated range in the percentage of material passing sieves No. 4, 10, and 200 reflects a normal range in grain size that occurs in any given soil. The texture (grain size) of any soil, especially that of alluvial materials, varies considerably. It should not, therefore, be assumed that all samples of a soil will fall within the ranges shown in table 7, and that the engineering classifications of that soil will always be the same as those shown.

Permeability refers to the rate at which water moves through undisturbed soil material. It depends largely on texture and structure of the soil. The permeability ratings used in this report and their equivalents in words are as follows:

Inches per hour	*Rating*
0.05 to 0.2	Slow
0.2 to 0.8	Moderately slow
0.8 to 2.5	Moderate
2.5 to 5.0	Moderately rapid
5.0 to 10.0	Rapid
Over 10	Very rapid

Available water capacity, measured in inches of water per inch of soil, is an estimate of the water available for plant use. It is the water held in a soil between field capacity and permanent wilting point.

The shrink-swell potential is the change in volume to be expected with a change in moisture content. In general, it is related to soil texture. In table 7 the shrink-swell potential of plastic silts and clays is rated as *high*, and that of nonplastic soils with no potential change in volume is rated as *none*. Soils that are intermediate in content of silt and clay and have a low or moderate plasticity index are rated as *low* or *moderate*. The low and moderate ratings of some soils were obtained by comparing the soils with others of known mechanical analysis or plasticity rating. In Deuel County the only soil material that has high shrink-swell potential occurs in some horizons of the inextensive Dawes and Scott soils and Slickspots. Of these, only the Dawes soils are on the uplands.

Table 7 does not give the reaction of individual soils in the county. The reaction of a soil, its acidity or alkalinity, is generally expressed in pH values. In the soils of Deuel County, the reaction generally ranges from pH 7.0 to 8.0 in the surface layer and from pH 7.5 to 8.5 in the lower horizons. Generally, the soils are only slightly saline, and their content of soluble salts is 0.07 percent or less.

Some soils on the bottom lands and low terraces contain variable amounts of excess sodium, or soluble salts, or both. The Laurel soils and most areas of Slickspots are strongly saline-alkali. In these soils the concentration of soluble salts ranges from 0.2 to 0.6 percent and, except where the surface layer of Slickspots is only moderately alkali, the reaction ranges from pH 9.0 to 10.0. The subsurface horizons of the Las and Nunn soils contain moderate amounts of excess sodium, or soluble salts, or both. In these soils the reaction ranges from pH 8.5 to 9.0, and the concentration of soluble salts ranges from 0.1 to 0.3 percent.

Dispersion is generally not a problem in this county, though the rate of dispersion is high in the Laurel soils and Slickspots and is moderate in the Las and Nunn soils.

ENGINEERING INTERPRETATIONS OF SOILS

Table 8 rates the suitability of the soils for specific uses in engineering. Also listed in the table are the characteristics that affect the use of the soils for highways and for conservation engineering practices.

The ratings given the soils as a source of topsoil, of sand, and of sand and gravel apply only in Deuel County. Some soils are rated poor or fair as a source of topsoil because they are eroded, are low in natural fertility or content of organic matter, or have a heavy surface layer that is sticky when wet and is difficult to handle or to work. For the soils that are rated fair or good as possible sources of sand or of sand and gravel, extensive exploring may be required to find material that will meet gradation requirements.

The suitability of the soils as material for road subgrade is shown for pavement (bituminous or concrete) and for gravel roads. The ratings in the column headed Paved refer to the subgrade of the roadbed for bituminous and concrete pavement. Because properly confined sand is the best subgrade for roads of this type, the soil is rated *good* for the subgrade if the AASHO classification is A–1 or A–3; *good to fair*, if A–2; *fair to poor*, if A–4; and *poor*, if A–6 or A–7.

In the column headed Gravel, the ratings refer to that part of the subgrade that receives gravel surfacing. Because sand is noncohesive, it does not provide a stable surface. Rated *poor*, therefore, are all soils classified A–1 or A–3 and those soils classified A–2 that do not have adequate plasticity. Rated *good to fair* are soils classified A–4 and soils classified A–2 that have adequate plasticity. Silts or clay soils classified A–5 to A–7 are rated *good* because they are generally acceptable for use in the part of the upper subgrade that receives gravel surfacing.

In the column headed Road fill, ratings of the soils were based on about the same criteria as the ratings of the soils for subgrade under bituminous or concrete pavement.

In all three columns, a range in a rating indicates that the profile of the soil varies.

In general, the soil features listed in table 8 as affecting engineering practices were rated according to the extent of the problems they might cause in the construction and maintenance of highways and of agricultural structures and practices. The soil features shown for a given soil were based on the profile of that soil, as described in table 7. A variation in this profile will change the ratings of the soil for use in some structures and practices.

Frost action is a common but not a major soil engineering problem in the county, though a few inextensive soils contain a large amount of clay and are highly susceptible to frost action. The ratings in the column headed Highway location were made on the basis of the texture of the surface soil and the subsoil. Clays and silts are susceptible to frost action if the underlying soil layers are pervious enough to permit water to rise and form ice lenses.

Soils for which the results of complete mechanical analyses are available are rated for susceptibility to frost action according to data in "Control of Soils in Military Construction" (*18*). For soils having 64 percent or more of the surface soil consisting of grains between 0.074 and 0.005 millimeter in size, susceptibility to frost action is *very high* if less than 44 percent of the subsoil consists of grains finer than 0.005 millimeter and is *high* if this percentage is 44 or more. For soils having between 50 and 63 percent of the surface soil in grains between 0.074 and 0.005 millimeter in size, susceptibility is *high* if less than 44 percent of the subsoil consists of grains finer than 0.005 millimeter and is *moderate* if this percentage is 44 or more.

For soils having between 35 and 49 percent of the surface soil in grains between 0.074 and 0.005 millimeter in size, susceptibility is *moderate* if less than 50 percent of the subsoil consists of grains finer than 0.005 millimeter and is *low* if this percentage is 50 or more. Regardless of the percentage of grains smaller than 0.005 millimeter in the subsoil, (1) soils having less than 35 percent of the surface soil in grains between 0.074 and 0.005 millimeter, and more than 3 percent finer than 0.02 millimeter, are *low* in susceptibility to frost action, (2) fine sands of uniform texture having 4 to 10 percent of the surface soil in grains finer than 0.02 millimeter are generally not susceptible to frost action, and (3) sands having 3 percent or less of the surface soil in grains finer than 0.02 millimeter are not susceptible to frost action.

Soils that had not been mechanically analyzed were rated by comparing them with soils that had been analyzed or whose properties were known.

For foundations the bearing quality and piping hazard are rated for that part of the soil below a depth of 3 feet.

The information given for low dikes and levees applies only to the upper 18 inches of the soil. If larger dikes or levees are planned, a detailed investigation of sites is needed.

Most reservoirs above small earth dams lose water through seepage because they are on soils that have sandy or gravelly lower horizons. Sealing is needed to control the loss.

If compacted embankments are constructed of material other than sand or sand and gravel, they are generally impervious and have good to poor stability, but toe drains may be required. Workability of soil materials is good for most soils except a few that occur on the bottom lands and have a plastic subsoil.

The type of agricultural drainage that can be effectively used is determined by relief, soil permeability, the height of the water table, and the availability of outlets. Some soils on bottom lands have imperfect or poor natural drainage because they have a seasonally high water table, or are slowly permeable, or both. Also, a few of the soils are subject to overflow. Others are nearly level and have slow runoff.

Under the column headed Irrigation, soil features affecting available water (water-holding capacity and water-intake rate) are rated. Irrigation hazards that are caused by slope are not shown. The "Nebraska Irrigation Guide for Central and Eastern Nebraska" issued in September 1959, contains information on the suitability of various soils and slopes for irrigation and on the use of soil amendments. The ratings for water-holding capacity in table 8 are for the top 4 feet of soil. To indicate the amount of water held, the terms are—

Water-holding capacity	*Rating*
More than 8 inches	High
5 to 8 inches	Moderate
3 to 5 inches	Low
Less than 3 inches	Very Low

The intake of water is shown only if the rate is *rapid* or *slow*. A *slow* intake rate is less than one-half inch per hour, and a *rapid* intake rate is 2 inches or more per hour. If the intake rate is not shown, it falls between these two extremes. For all soils the intake rate is based on border or sprinkler irrigation of areas that are covered with plants.

Terraces are commonly used in this county to conserve soil and water. Below grassland, diversions can be used in some places to protect lower lying soils, for many of the soils are very productive, though highly erodible. The slopes of terraces also are generally erodible, but in most places the cost of maintaining them is not extremely high. Exceptions to this may be terraces built on gravelly or sandy soils in the Canyon, Dix, Anselmo, and Rosebud series. In addition, the use of terraces in the county may be limited by steep, irregular, or hummocky slopes. Waterways are not widely needed in the county.

The suitability of the soils for winter grading is not rated in table 8. Whether or not a soil can be graded in winter depends on the moisture content of the soil and on temperature, both of which vary from year to year. In Deuel County, rainfall is normally light in fall, and some fairly warm days generally occur in winter. Consequently, most of the soils are suitable for winter grading. On the bottom lands, however, some soils have a high water table and generally cannot be graded in winter.

Descriptions of Soils

This section describes the soil series (groups of soils) and single soils (mapping units) of Deuel County. The acreage and proportionate extent of each mapping unit are given in table 9.

The procedure in this section is to describe first the soil series and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. As mentioned in the section "How Soils Are Mapped and Classified," not all mapping units are members of a soil series. Sandy alluvial land does not belong to a soil series but, nevertheless, is listed in alphabetical order along with the soil series.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit is the capability unit and the range site in which the mapping unit has been placed. For soils that can be used as woodland, also listed is the woodland site. The page on which each capability unit and each range site is described can readily be found by referring to the "Guide to Mapping Units" at the back of the report.

Soil scientists, engineers, students, and others who want detailed descriptions of the soil series should turn to the section "Formation and Classification of the Soils." Many terms used in the soil descriptions and in other sections of the report are defined in the Glossary.

Altvan Series

In the Altvan series are moderately deep, dark-colored, loamy soils of the uplands that are underlain by mixed sand and gravel. These soils occur on the breaks along Lodgepole Creek and the South Platte River and in areas adjacent to upland drainageways.

Altvan soils have a very dark grayish-brown surface layer about 7 inches thick (fig. 19). It has granular structure and is very friable when moist. In many places

TABLE 9.—*Approximate acreage and proportionate extent of the soils*

Map symbol	Soil	Area	Extent
		Acres	*Percent*
3AB	Altvan loam, 3 to 5 percent slopes	3, 984	1. 4
3AB2	Altvan loam, 3 to 5 percent slopes, eroded	3, 981	1. 4
ACC	Altvan-Chappell complex, 5 to 9 percent slopes	11, 735	4. 2
ACC2	Altvan-Chappell complex, 5 to 9 percent slopes, eroded	3, 283	1. 2
An	Anselmo fine sandy loam, 0 to 1 percent slopes	180	([1])
AnB	Anselmo fine sandy loam, 1 to 5 percent slopes	1, 520	. 5
AnC	Anselmo fine sandy loam, 5 to 9 percent slopes	293	. 1
AoBW	Anselmo loamy fine sand, 0 to 5 percent slopes	1, 063	. 4
AoCW	Anselmo loamy fine sand, 5 to 9 percent slopes	187	. 1
Bw	Bayard loam, 0 to 1 percent slopes	299	. 1
Bf	Bayard fine sandy loam, 0 to 1 percent slopes	2, 013	. 7
BH	Bridgeport and Havre loams, 0 to 1 percent slopes	97	([1])
BHA	Bridgeport and Havre loams, 1 to 3 percent slopes	25	([1])
CD	Canyon complex	1, 162	. 4
ChA	Chappell sandy loam, 0 to 3 percent slopes	6, 057	2. 2
Cy	Cheyenne loam, 0 to 1 percent slopes	979	. 4
CyA	Cheyenne loam, 1 to 3 percent slopes	6, 339	2. 3
CUB	Colby-Ulysses silt loams, 3 to 5 percent slopes	200	. 1
CUD	Colby-Ulysses silt loams, 5 to 15 percent slopes	1, 555	. 6
DK	Dawes-Keith loams, 0 to 1 percent slopes	2, 288	. 8
DKA	Dawes-Keith loams, 1 to 3 percent slopes	415	. 2
DxD	Dix complex, 5 to 20 percent slopes	7, 389	2. 7
DxE	Dix complex, 20 to 30 percent slopes	7, 315	2. 6
DCD	Dix-Chappell loams, 9 to 15 percent slopes	4, 206	1. 5
Du	Dunday loamy fine sand	878	. 3
Gf	Goshen fine sandy loam, 0 to 3 percent slopes	244	. 1
Gh	Goshen silt loam, 0 to 1 percent slopes	13, 259	4. 8
GhA	Goshen silt loam, 1 to 3 percent slopes	1, 673	. 6
KeB	Keith silt loam, 3 to 5 percent slopes	6, 367	2. 3
KeB2	Keith silt loam, 3 to 5 percent slopes, eroded	15, 408	5. 5
KeC	Keith silt loam, 5 to 9 percent slopes	693	. 2
KeC2	Keith silt loam, 5 to 9 percent slopes, eroded	2, 124	. 8
KK	Keith-Kuma silt loams, 0 to 1 percent slopes	26, 978	9. 7
KR	Keith-Richfield silt loams, 0 to 1 percent slopes	31, 229	11. 2
KRA	Keith-Richfield silt loams, 1 to 3 percent slopes	66, 351	23. 8
KT	Keith and Tripp fine sandy loams, 0 to 3 percent slopes	3, 657	1. 3
KTB	Keith and Tripp fine sandy loams, 3 to 5 percent slopes	443	. 2
KTB2	Keith and Tripp fine sandy loams, 3 to 5 percent slopes, eroded	1, 739	. 6
KTC2	Keith and Tripp fine sandy loams, 5 to 9 percent slopes, eroded	385	. 1
Lt	Las loam	3, 712	1. 3
Lc	Las Animas fine sandy loam	1, 542	. 6
Lw	Las Animas loamy sand	277	. 1
LS	Laurel soils	200	. 1
Na	Nunn silt loam	1,335	.5
NS	Nunn-Slickspots complex	670	.2
RbA	Rosebud loam, 0 to 3 percent slopes	2,040	.7
RbB	Rosebud loam, 3 to 5 percent slopes	899	.3
RbB2	Rosebud loam, 3 to 5 percent slopes, eroded	3,463	1.2
RCC	Rosebud-Canyon complex, 5 to 9 percent slopes	1,104	.4
RCC2	Rosebud-Canyon complex, 5 to 9 percent slopes, eroded	1,057	.4
RCD	Rosebud-Canyon complex, 9 to 15 percent slopes	385	.1
RdB	Rosebud fine sandy loam, 3 to 5 percent slopes	284	.1
RdB2	Rosebud fine sandy loam, 3 to 5 percent slopes, eroded	364	.1
RdC	Rosebud fine sandy loam, 5 to 9 percent slopes	371	.1
RdC2	Rosebud fine sandy loam, 5 to 9 percent slopes, eroded	182	.1
Sx	Sandy alluvial land	5,770	2.1
Sc	Scott silty clay loam	2,654	1.0
Ss	Slickspots	1,065	.4
TK	Tripp-Keith silt loams, 0 to 1 percent slopes	3,366	1.2
TKA	Tripp-Keith silt loams, 1 to 3 percent slopes	3,403	1.2
VaD	Valentine fine sand, hilly	180	.1
VaC	Valentine fine sand, rolling	3,317	1.2
Wm	Wann loam	405	.2
Wx	Wet alluvial land	2,362	.8
	Total	278,400	100.0

[1] Less than 0.05 percent.

small pebbles are scattered on the surface and in the surface layer.

The subsoil is dark grayish-brown sandy clay loam or clay loam about 18 inches thick. Generally, small pebbles are scattered throughout. The moderate, coarse prisms of the structure break into weak, medium-sized blocks. Lime is normally lacking, but the lower part of the subsoil contains free carbonate of lime in some places. The subsoil is friable when moist and is easily penetrated by roots.

Limy gravel and coarse sand underlie these soils at an average depth of about 34 inches. In many places the upper part of the gravel and sand contains silt and clay and is slightly plastic when wet. The gravel restricts penetration of plant roots.

Altvan soils are deeper and are less gravelly than Dix soils. They are slightly more sandy than Keith soils but are not so deep and are underlain by sand and gravel instead of loess. The Altvan soils contain more silt and clay than do the Chappell soils and are less limy than Rosebud soils. The Rosebud soils are underlain by limy sandstone.

The Altvan soils are somewhat deeper where they occur below the steep Dix complex of soils than where they occur below the more gently sloping Keith soils. The depth to beds of sand and gravel ranges from 20 to 38 inches.

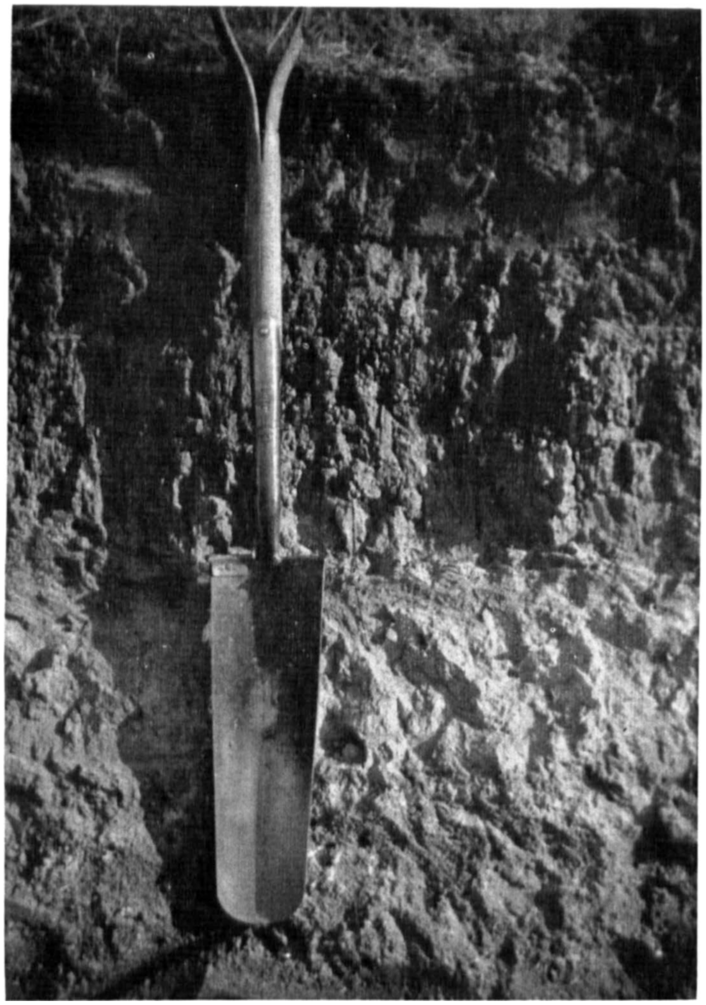

Figure 19.—**Profile of Altvan loam.**

The surface layer is uniform in thickness, but the subsoil ranges from 10 to 20 inches in thickness. In many of the deeper places, a layer of light-colored, limy silt loam is between the subsoil and the beds of sand and gravel.

Altvan soils are easily tilled. They are naturally well drained and are medium in natural fertility. Surface runoff is medium to rapid, and permeability is moderate. The available water capacity is high. Erosion, especially by wind, is a hazard.

Altvan soils are not irrigated. Most areas are in native grass, but a few are cultivated, principally to wheat. These soils are well suited to small grain and to native grass.

Altvan loam, 3 to 5 percent slopes (3AB).—This soil is undulating and occurs in areas that are generally small and are more widely scattered than are areas of the steeper Altvan-Chappell complex. Included with this soil are areas that have a sandy loam surface layer and make up about 10 percent of the acreage mapped. Also included are Cheyenne soils on slopes of about 3 percent and, in some places, small areas of Keith, Chappell, and Rosebud soils. Nearly all of this soil is in native grass. (Capability unit IVe-1, dryland; Silty range site; Silty to Clayey woodland site)

Altvan loam, 3 to 5 percent slopes, eroded (3AB2).—This undulating soil has a surface layer that is only about 5 inches thick. Because it has lost organic matter through erosion, the surface layer is slightly lighter in color than that of Altvan loam, 3 to 5 percent slopes, and is more susceptible to erosion. In places tillage has mixed upper subsoil material with the original surface layer.

Included with this soil are a few small, severely eroded areas where all of the original surface layer has been lost. Also included in about 10 percent of the acreage mapped are areas that have a sandy loam surface layer. Other inclusions are small areas of Keith, Chappell, and Rosebud soils.

This soil occurs in small areas that are scattered more widely than areas of the steeper Altvan-Chappell complex. Nearly all this soil is cultivated, mainly to wheat. A few areas that were recently cultivated have been seeded to native grass. (Capability unit IVe-1, dryland; Silty range site; Silty to Clayey woodland site)

Altvan-Chappell complex, 5 to 9 percent slopes (ACC).—This complex is made up of soils of several series that occur in such intricate patterns that mapping the soils separately is impractical. About 40 to 60 percent of the complex is Altvan soils, and about 25 to 50 percent is Chappell soils. These soils have a surface layer of loam or sandy loam. Included are small areas of Dix, Rosebud, and Keith soils. The complex is in rolling areas that are generally large and irregularly shaped. In most places slopes of the Altvan soils are convex and those of Chappell soils are concave.

This is the largest unit of Altvan soils and Chappell soils. Nearly all of the acreage is in native grass. (Capability unit IVe-1, dryland; Silty range site; Silty to Clayey woodland site)

Altvan-Chappell complex, 5 to 9 percent slopes, eroded (ACC2).—The soils in this complex are similar to those described for the Altvan-Chappell complex, 5 to 9 percent slopes, but their surface layer is thinner, has a much lower content of organic matter, contains material brought up from the upper subsoil in cultivation and, consequently, is lighter in color. Included are small, severely eroded areas that have lost all of their original surface layer.

This complex is about 40 to 60 percent Altvan soils and about 25 to 50 percent Chappell soils. These soils have a loam or a sandy loam surface layer. Slopes of the Altvan soils are generally convex, and those of the Chappell soils are concave. Small areas of Dix, Rosebud, and Keith soils are included. All of the soils are so intermingled that they could not be mapped separately. They occur in rolling areas that are smaller than those of the Altvan-Chappell complex, 5 to 9 percent slopes.

Nearly all the acreage is cultivated. Wheat is the principal crop. A few areas that were formerly cropped have been seeded to grass; these still show the effects of erosion. (Capability unit IVe-1, dryland; Silty range site; Silty to Clayey woodland site)

Anselmo Series

The Anselmo series consists of deep, moderately sandy soils on nearly level to rolling uplands that are transitional

between the hardlands and the sands. These immature soils are smooth or hummocky and generally occupy long, narrow, incomplete ridges that extend in a northwest-southeast direction. They occur mainly in two fairly small areas in Deuel County. One area is in the south-central part, about 5 miles southeast of Chappell and 2 miles east of Lodgepole Creek . The other area is in the northeastern part, about 7 miles northwest of Big Springs.

The surface layer of Anselmo soils is very dark grayish brown and is about 10 inches thick. It has a granular structure and is very friable.

The subsoil is dark grayish-brown to dark-brown fine sandy loam that is thick and is very friable when moist. Its structure consists of weak, coarse prisms. In some places there is more clay in the subsoil than in the surface layer.

The parent material is a brown or pale-brown mixture of sand and silt that was deposited by wind and has slight to moderate coherence. It is fine sandy loam to loamy sand and is easily penetrated by roots. In some places the parent material is limy in the lower part.

The Anselmo soils are more sandy than the Keith soils and have a sandy loam instead of a silty subsoil. Anselmo soils are less sandy and more coherent than the Dunday and Valentine soils.

The surface layer of the Anselmo soils ranges from 6 to 16 inches in thickness and is sandy loam or loamy sand. The subsoil is 12 to 30 inches thick. In many places the subsoil is an indistinct layer of transition between the surface layer and the parent material.

The natural drainage of these soils is somewhat excessive. Permeability is moderate. Surface runoff is slow to medium, depending on the slope. Natural fertility is low to medium, and the available moisture capacity is moderately low. The Anselmo soils are easily worked but are droughty. They are susceptible to water erosion, and they tend to blow if not protected.

These soils are suited to small grain, row crops, and native grass. They are mostly cultivated but are not irrigated. The principal crop is wheat, though grain sorghum and corn also are grown.

Anselmo fine sandy loam, 0 to 1 percent slopes (An).—This inextensive soil occurs in small, nearly level areas that are long and narrow and generally lie between sloping sandy ridges. Its surface layer and subsoil are thicker and darker than those of other Anselmo soils. Included with this soil in some places are small areas of Goshen soils.

All crops commonly grown in the county are suited to this soil. Cultivated areas should be protected from wind erosion by stubble mulching. (Capability unit IIe-3, dryland; Sandy range site; Sandy woodland site)

Anselmo fine sandy loam, 1 to 5 percent slopes (AnB).—This is the most extensive of the Anselmo soils. It occupies small, very gently sloping or undulating areas chiefly in the south-central and northeastern parts of the county. Also, there are widely scattered areas on the breaks along Lodgepole Creek and the South Platte River.

Most of this soil is cultivated and eroded. The surface layer has lost fine materials and organic matter and, in most places, is only about 7 inches thick. Included with this soil are some slightly eroded areas in native grass and a few slightly eroded ones in cultivation. Also included are small, scattered, severely eroded areas where the surface layer is thinner than 7 inches; small areas that have a surface layer of loamy fine sand; and small areas of Keith and Tripp fine sandy loams.

If this soil is farmed, terracing and contour farming are needed to help control water erosion and conserve moisture for crops. Keeping the surface covered by stubble mulch or growing crops prevents wind erosion and adds nutrients that maintain or increase crop yields. (Capability unit IIIe-3, dryland; Sandy range site; Sandy woodland site)

Anselmo fine sandy loam, 5 to 9 percent slopes (AnC)—Nearly all of this inextensive soil is cultivated. The soil occurs on complex slopes in rolling areas. It is in small bodies scattered within the two main areas of Anselmo soils and also along the breaks of the major streams. Because the soil is eroded, the surface layer is only 6 or 7 inches thick and is lighter colored and slightly more sandy than the surface layer of uneroded Anselmo soils. Included with this soil are a few small, slightly eroded areas, a few severely eroded areas, and small areas on slopes slightly steeper than 9 percent.

If used for cultivated crops and not protected, this soil is likely to be eroded by wind and water. Erosion can be controlled if the cropping system provides for keeping the soil covered by a growing crop or by crop residue. Row crops can be safely grown once in 4 years. (Capability unit IVe-3 dryland; Sandy range site; Sandy woodland site)

Anselmo loamy fine sand, 0 to 5 percent slopes (AoBW).—This nearly level to undulating soil occurs mainly in an area southeast of Chappell. The greater part of the acreage is cultivated and eroded, and large areas that were recently cultivated have been returned to native grass. The plow layer has been shifted about by the wind, has lost much fine material and organic matter, and now is loamy fine sand or loamy sand in texture. In cultivated fields the plow layer is loose and is very susceptible to further erosion. Included with this soil are some slightly eroded areas and a few, small, severely eroded ones. Also included are areas of Anselmo fine sandy loam and of Keith and Tripp fine sandy loams.

Because the risk of blowing is severe, and because fertility and the available water capacity are low, it is best to keep this soil permanently in grass or in grasses and legumes. If the soil is cultivated, wind erosion can be reduced by stubble-mulch farming and by growing chiefly small grain. (Capability unit IVe-5, dryland; Sandy range site; Sandy woodland site)

Anselmo loamy fine sand, 5 to 9 percent slopes (AoCW).—This inextensive soil is in small tracts that occur on ridges within areas of other Anselmo soils and of Keith and Tripp fine sandy loams. It is on rolling slopes that are generally cultivated and eroded. A few areas bordering sandhills are in native grass, and small areas recently cultivated have been seeded to grass. In unprotected fields much fine material has been removed from the surface layer by winnowing. The surface layer is light-colored loamy fine sand or loamy sand about 6 inches thick.

This soil is not suited to cultivated crops. Its best use is grasses and legumes for hay and pasture. Among the native grasses suitable for seeding are switchgrass, sand lovegrass, and big bluestem. Newly seeded grass on eroded areas responds to light applications of fertilizer.

(Capability unit VIe-5, dryland; Sands range site; Very Sandy woodland site)

Bayard Series

Soils of the Bayard series are deep, nearly level, dark colored, and moderately sandy. They are immature soils that developed in calcareous colluvium and alluvium of uniform texture. They occur on the high bottoms and terraces of Lodgepole Creek and the South Platte River. (See fig. 9, p. 7.)

The very dark grayish-brown surface layer is about 19 inches thick. It has granular structure in the upper part and coarse, blocky structure in the lower part. This layer is friable and is calcareous.

The subsoil is a 4- to 9-inch layer of dark grayish-brown fine sandy loam that is transitional between the surface horizon and the parent material. It has weak, coarse, blocky structure and is calcareous.

The calcareous parent material is grayish brown or light brownish gray. It is mainly fine sandy loam but is more sandy in the lower layers than in the upper. The upper layers have weak, coarse, prismatic structure, and the lower layers are structureless. In some places the parent material contains silty strata deep in the underlying sediments. The parent material is soft when dry and very friable when moist; it is easily penetrated by plant roots.

Bayard soils are deeper and less gravelly than Cheyenne soils and are more sandy in the upper horizons. They are deeper, less gravelly, and more uniform in texture than Chappell soils. Bayard soils are on terraces in positions similar to those of Tripp and Keith soils, but they are sandier and are less well developed.

The surface layer ranges from 10 to 20 inches in thickness. It is noncalcareous in some places. A transitional layer is lacking in some places but is as much as 9 inches thick in others. The sandy loam parent material commonly contains strata of loamy sand, very fine sandy loam, and, deep in the profiles, silt loam. In some places the soil contains a small amount of gravel.

The natural drainage of Bayard soils is somewhat excessive. Surface runoff is slow, and permeability is moderately rapid. Natural fertility is medium. These soils are easily worked but have moderately low available water capacity and are droughty. They are very susceptible to wind erosion and tend to blow if not protected.

The Bayard soils are suited to small grain, row crops, and native grass. They are well suited to irrigation. Some of the acreage is irrigated, and the rest is in dryland cultivation or in native grass. The main crops are corn under irrigation and wheat under dryland farming. Grain sorghum is another important crop.

Bayard fine sandy loam, 0 to 1 percent slopes (Bf).—This soil occurs on high terraces. The largest areas are along Lodgepole Creek, and there are smaller ones along the South Platte River. Included are a few small areas of Cheyenne and Chappell soils and areas of medium-textured Bridgeport soils and lighter colored Havre soils.

All crops commonly grown in the county are well suited to this soil. Keeping crop residue on or near the surface conserves moisture and prevents wind erosion. Under irrigation, the soil responds well to nitrogen fertilizer. (Capability unit IIe-3, dryland; IIe-3, irrigated; Sandy range site; Sandy woodland site)

Bayard loam, 0 to 1 percent slopes (Bw).—Only a few areas of this soil occur in the county. These areas are on high bottoms where the natural slope is slightly convex, though most of the soil has been leveled for irrigation. Generally the areas are long and narrow, are 5 to 65 acres in size, and are surrounded by nearly level soils that contain more silt than does this soil. Some areas included have a subsoil that is more silty than is typical for Bayard soils and commonly contains an appreciable amount of sodium. Also included are a few areas with a sandy loam surface layer.

This is one of the best soils in the county for farming. It is only slightly eroded but, if cultivated, needs practices to prevent further erosion. Stubble mulching protects the soil from strong winds and conserves moisture. A cropping system should be used that maintains fertility and the content of organic matter. In irrigated areas, fertilizer is needed and should be applied in amounts determined by field trials or soil tests. (Capability unit IIc-1, dryland; I-1, irrigated; Silty range site; Silty to Clayey woodland site)

Bridgeport Series

Soils of the Bridgeport series are deep, light colored, loamy, and calcareous. They are nearly level or very gently sloping soils that occupy colluvial-alluvial fans on stream terraces in only two small areas of the county. One area is along Lodgepole Creek near the Colorado line; the other is along the South Platte River north of Julesburg, Colorado. These immature soils are more extensive in Sedgwick County, Colorado, which joins Deuel County on the south.

These soils have a very dark grayish-brown or dark grayish-brown surface layer 8 inches thick. It is limy, friable, and granular in structure.

The subsoil is transitional between the surface layer and the parent material. It is dark grayish-brown very fine sandy loam that averages about 8 inches in thickness and is limy and very friable. It has weak, coarse, blocky structure.

The parent material is grayish-brown, loamy colluvium and alluvium that is stratified with sand and darker colored silt. This material was recently deposited and is limy, very friable, and structureless. It generally is more sandy with increasing depth and is easily penetrated by plant roots.

The Bridgeport soils occur with the Tripp soils and are lighter colored, more limy, slightly more sandy, and less well developed. They occur closely with the alluvial soils of the Havre series.

The surface layer of the Bridgeport soils ranges from silt loam to very fine sandy loam in texture and from 6 to 10 inches in thickness. The transitional subsoil is loam or very fine sandy loam and is 6 to 20 inches thick. It is underlain by stratified parent material that ranges from silt loam to fine sandy loam in texture and from dark grayish brown to light brownish gray in color.

These soils are naturally well drained. Surface runoff is slow, permeability is moderate, and the available water capacity is high. Natural fertility is medium to low. Water erosion is not a serious problem, but blowing is a hazard on unprotected fields.

Bridgeport soils are well suited to irrigated crops and are all under irrigation. The principal crops are corn, alfalfa, and sugar beets (fig. 20).

Bridgeport and Havre loams, 0 to 1 percent slopes (BH).—This undifferentiated group of soils occurs in only a few small areas on nearly level slopes. Areas of these soils are slightly eroded. Included are a few very small areas of more sandy Bayard soils and of darker colored Tripp soils.

The soils of this unit are suited to all crops commonly grown in the county and produce high yields under good management. They respond well to added fertilizer. Erosion can be controlled by stubble mulching. (Capability unit IIc–1, dryland; I–1, irrigated; Silty range site; Silty to Clayey woodland site)

Bridgeport and Havre loams, 1 to 3 percent slopes (BHA).—This undifferentiated unit occurs on fans that are very gently sloping and are slightly convex. The soils developed in sediments laid down recently, and there is little or no erosion. Small areas of Tripp and Bayard soils are included.

Where these soils are used for dryland crops, farming along the contour and keeping crop residue on or near the surface are needed to conserve moisture and to control erosion. Some irrigated fields can be improved by bench leveling on the contour. Apply fertilizer according to needs indicated by field trials and soil tests. (Capability unit IIe–1, dryland; IIe–1, irrigated; Silty range site; Silty to Clayey woodland site)

Canyon Series

The Canyon series consists of shallow, loamy soils on the uplands that developed in limy sandstone. These soils are undulating to steep and generally occupy isolated knolls or knobs that are high and irregularly shaped. One of the larger areas of Canyon soils is in the southwestern part of the county, about 6 miles west and 2 miles south of Chappell.

The very dark grayish-brown surface layer is about 6 inches thick and has weak, fine, granular structure. It has a high content of lime carbonate and is very friable when moist. The surface is nearly covered with hard, white fragments of sandstone that range from 2 millimeters to about 8 inches across.

The parent material lies directly below the surface layer. The upper part of it consists mainly of light-colored, soft, limy sandstone that is about 8 inches thick and contains many fragments of hard sandstone. This horizon is slightly darkened by organic matter and is more highly weathered than the layer below. It is easily penetrated by plant roots.

The underlying material is a weakly consolidated mass of limy sandstone that is nearly white. It varies in degree of hardness but hinders the penetration of plant roots.

The Canyon soils occur with the Rosebud soils and are shallower than those soils. In some places they occupy positions similar to those of Dix soils, but Canyon soils developed in limy sandstone, whereas Dix soils developed in beds of sand and gravel.

The principal variation in these soils is the depth to limy sandstone. The depth to this weakly consolidated material ranges from about 10 to 20 inches. Hard fragments of sandstone on the surface and in the upper horizons vary from few to many.

The Canyon soils are somewhat excessively drained or excessively drained. Because of the underlying strata of sandstone, permeability is slow. Surface runoff is medium to very rapid, depending on steepness of slope. The available water capacity and natural fertility are low. Where the soils are cultivated, they are susceptible to wind and water erosion.

The Canyon soils are difficult to till because their surface is rocky. They are best suited to native grass. These soils commonly occur as high spots within fields of soils well suited to cultivation. Consequently, much of the acreage is cropped, principally to wheat. However, along the breaks of Lodgepole Creek and the South Platte River, most areas remain in native grass.

Canyon complex (CD).—This complex consists of shallow, undulating to steep Canyon soils that occur in such an intricate pattern that it was not practical to map them separately (fig. 21). The degree of erosion ranges from none to severe. Rock crops out in places on the steeper slopes. About 10 to 15 percent of the acreage consists of

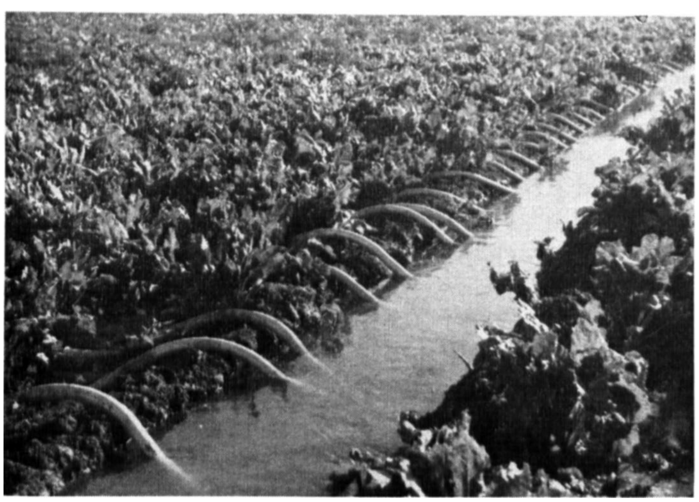

Figure 20.—**Sugar beets on irrigated Bridgeport soils in the valley of Lodgepole Creek.**

Figure 21.—**Landscape of Canyon soils in southwestern Deuel County.**

very shallow soils that are less than 10 inches thick over bedrock. Also included are a few small, very steep areas on slopes of about 30 percent, and there are small areas of Rosebud soils in some places.

These soils are suited to native grass used for pasture. Small areas in cultivated fields require a continuous cover of growing crops or crop residue to control erosion. New stands of seeded grass should not be grazed until the grass is well established, which generally takes 1 or 2 years. (Capability unit VIs-4, dryland; Shallow Limy range site; Shallow woodland site)

Chappell Series

In the Chappell series are moderately deep, dark, moderately sandy soils of the uplands and high terraces. These soils are weakly or moderately developed Chestnut soils that are underlain by mixed sand and gravel. They occur on the breaks along Lodgepole Creek and the South Platte River and on slopes and fans adjacent to upland drainageways. (See fig. 4, p. 4.)

The surface layer is very dark grayish brown and is about 7 inches thick. It is granular and is very friable when moist. In most places gravel is scattered on the surface and in the surface layer.

The subsoil, about 15 inches thick, is very dark grayish-brown or dark grayish-brown sandy loam that contains scattered gravel. It has weak, coarse, prismatic structure, is friable, and generally is leached of lime carbonate.

Underlying these soils are limy gravel and coarse sand at an average depth of about 28 inches. In some places the upper part of this horizon contains clay and is slightly cohesive. This coarse-textured layer restricts the growth of plant roots.

The Chappell soils are deeper to beds of sand and gravel than the Dix soils. They are coarser textured than Altvan soils but in other respects are similar. The Chappell soils resemble Rosebud fine sandy loam but developed from mixed sand and silt over gravel instead of from limy sandstone.

The thickness in the horizons of these soils depends largely on the depth to beds of sand and gravel. The depth ranges from 20 to 36 inches. The surface layer ranges from about 6 to 15 inches in thickness and the subsoil from about 10 to 20 inches. Both the surface layer and the subsoil vary from sandy loam to loam.

The Chappell soils are well drained or somewhat excessively drained. They have moderate to moderately rapid permeability. Surface runoff is slow to medium. These soils are moderate or moderately low in available water capacity and are medium to low in natural fertility. They are easily worked with ordinary farm machinery but are susceptible to both wind and water erosion.

Chappell soils are suited to small grain and to native grass. Most of the less sloping areas are cultivated, principally to wheat. Where the slopes are more than 3 percent, the greatest part of the acreage is in native grass. A few small areas under irrigation are planted mainly to corn and alfalfa.

Chappell sandy loam, 0 to 3 percent slopes (ChA).—About four-fifths of the acreage of this soil is very gently sloping, and the rest is nearly level. About 10 percent of the acreage mapped as this soil is Sandy alluvial land, and about 5 to 10 percent is Cheyenne loam, 1 to 3 percent slopes. Also included are small areas that are deeper than normal and a few areas on nearly level terraces that are uniformly sandy loam throughout the profile.

The soil is well suited to switchgrass, sand lovegrass, and other native grasses. If the soil is cultivated, it should be protected by a cover of growing crops or crop residue. Apply fertilizer to areas in crops or in new seedings of grass as indicated by field trials or soil tests. (Capability unit IVe-3, dryland; IIIe-3, irrigated; Sandy range site; Sandy woodland site)

Cheyenne Series

The Cheyenne series consists of moderately deep, dark, loamy soils on benchlands. These soils are weakly developed and are underlain by mixed sand and gravel. They are nearly level or very gently sloping and occur mainly on wide colluvial-alluvial fans along the upper edge of high terraces. (See fig. 4, p. 4.) They also occupy low slopes along the principal upland drainageways (fig. 22).

The surface layer is very dark grayish brown and is about 16 inches thick. Its structure is granular in the plow layer and is weak and blocky below. The surface layer contains many small pebbles. It is very friable when moist.

The subsoil is a weakly developed horizon that is transitional between the surface layer and the parent material. It is very dark grayish-brown or dark grayish-brown light loam or loam, generally between 6 and 12 inches thick. The subsoil has weak, blocky structure. In most places it contains more gravel than does the surface layer.

Underlying these soils at a depth of 20 to 36 inches is old alluvium that consists of mixed sand and gravel and is free of lime. In places it contains material that is silty or only slightly sandy and, in those places, is slightly cohesive, especially in the upper part. In many places sandy loam or loamy sand occurs in strata of varying thickness that restrict penetration of roots according to the content of gravel.

The Cheyenne soils are not so gravelly as the Chappell soils, and they have a more loamy subsoil. They are shallower and more gravelly than the Tripp and Keith soils but are not so silty as those soils. Cheyenne soils

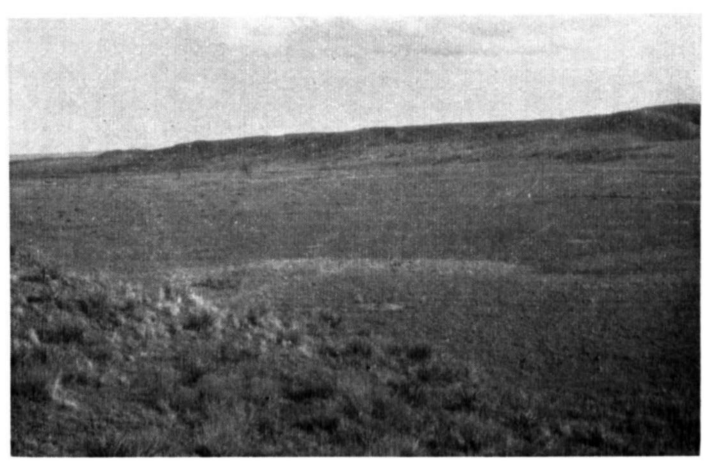

Figure 22.—Landscape of Cheyenne soils.

are younger and less well developed than Altvan soils; they occur at lower elevations and are more gently sloping.

The surface layer is uniformly thick and dark colored, but the subsoil ranges from about 6 to 16 inches in thickness. In the upper part of the soil, the content of gravel varies but is moderate in most places. The gravel commonly occurs in thin layers.

These soils are naturally well drained and are easily worked. Permeability and the available water capacity are moderate. Natural fertility is medium. Although surface runoff is slow, washing is a problem because the soils receive runoff from higher lying areas, and small rills and gullies form where the plant cover is sparse. The soils are also susceptible to wind erosion.

Cheyenne soils are suited to native grasses and to all irrigated and dryland crops grown in the county. The main irrigated crops are corn and alfalfa. Wheat is the principal dryland crop.

Cheyenne loam, 0 to 1 percent slopes (Cy).—This moderately deep soil occupies fairly small areas and is only slightly eroded. Much of the acreage is cultivated, though little is irrigated. The rest is in native grass. Included with this soil are areas that are deeper than 36 inches and areas of Tripp soils.

Where this soil is used for crops, it can be protected from damaging winds by stubble mulching. Under irrigation, the soil responds well to large applications of nitrogen. Soil tests or field trials will indicate the need for other kinds of fertilizer. Eroded areas should be seeded to native grass. (Capability unit IIIs–5, dryland; IIs–5, irrigated; Silty range site; Silty to Clayey woodland site)

Cheyenne loam, 1 to 3 percent slopes (CyA).—This soil, the more extensive of the two Cheyenne soils mapped, lies mainly on very gently sloping fans where erosion is only slight. It generally occurs in large areas that may be as much as 500 acres or more in size and are commonly broken by sandy and gravelly drains. Smaller areas are along upland drainageways. The soil is moderately deep and is of a more uniform depth than is Cheyenne loam, 0 to 1 percent slopes. The most common inclusions are of Chappell sandy loam on the colluvial-alluvial fans. Also included are a few areas that are less than 20 inches deep and a few areas of Tripp soils.

A large acreage of this soil is cultivated, but much of it has been left in native grass. Only a small acreage is irrigated. Suitable crops are small grain and sorghum. Erosion can be controlled by keeping crop residue on or near the surface and by farming the stronger slopes on the contour. Reseed eroded areas to grass or to a grass-legume mixture. (Capability unit IIIe–1, dryland; IIe–1, irrigated; Silty range site; Silty to Clayey woodland site)

Colby Series

The Colby series consists of thin, weakly developed, silty soils that formed in thick deposits of loess (fig. 23). These soils of the uplands occupy side slopes and high, rounded ridges that extend generally in a northwest-southeast direction. Nearly all the Colby soils occur in the northeastern part of Deuel County.

The 6-inch surface layer is very dark grayish brown or dark grayish brown when moist. It has granular structure, is soft when dry, and is very friable when moist. It is free of lime except in cultivated areas.

Figure 23.—**Profile of Colby silt loam.**

The subsoil is a thin transitional zone between the surface layer and the parent material. This layer consists of about 3 inches of silt loam and is limy. It has a weak, prismatic structure, is soft when dry, is very friable when moist, and is easily penetrated by roots.

The parent material consists of light-colored silt loam that was deposited by wind and contains much lime carbonate. This material is of weak, prismatic structure in the upper part and is structureless in the lower part. It is soft when dry, very friable when moist, and easily penetrated by roots.

Although the Colby soils have [illegible]t material like that of the Ulysses and Keith soils, t[illegible]re more calcareous and have a thinner surface layer than those soils, and their subsoil is not so dark or so well developed. In the Keith-Colby soil association (see fig. 6, p. 5), Colby soils are on steeper slopes than Ulysses and Keith soils.

These soils have a 4- to 8-inch surface layer that is very dark grayish brown to dark grayish brown when moist.

The natural drainage of the Colby soils is excessive. The soils are moderately permeable, have a high available moisture capacity, and release moisture readily to plants. Because slopes are hilly, however, surface runoff is rapid, and a large part of the precipitation is lost. Consequently, the soils are droughty and are highly susceptible to washing if not protected. The low content of organic matter causes poor aggregation and further increases the erosion hazard. Natural fertility is low.

Most of the Colby soils are in native grass, their best use. A few areas are included in fields of more productive soils and are cultivated. Winter wheat is the principal crop.

Colby-Ulysses silt loams, 3 to 5 percent slopes (CUB).—This inextensive complex is mainly on small, low ridges that occur within more gently sloping cultivated fields. It is 35 to 55 percent Colby silt loam and 30 to 50 percent Ulysses silt loam. These soils are so intermingled that they cannot be mapped separately. In most places erosion is only slight, but a few severely eroded spots are included. Also included are areas of Keith silt loam.

These soils are suited to small grain. If cultivated, they need terracing and contour farming to help conserve

water and prevent washing. Wind erosion can be controlled by keeping the surface covered with growing crops or crop residue. Eroded areas should be seeded to grass. (Capability unit IVe–9, dryland; Thin Silty range site; Silty to Clayey woodland site)

Colby-Ulysses silt loams, 5 to 15 percent slopes (CUD).—This is the largest unit of Colby soils and Ulysses soils in the county. About 40 to 60 percent of the complex is Colby silt loam, and about 25 to 45 percent is Ulysses silt loam. Mapping these soils separately is impractical because they occur in such intricate patterns. Slopes are dominantly hilly but are rolling in some places, and a few small included areas are steep. Erosion is slight or moderate, though a few small, severely eroded areas are included and are indicated by a symbol on the soil map. Also included are small areas of Keith silt loam on slopes of less than 10 percent.

These soils are best suited to native grass. Eroded areas can be reseeded successfully if they are first covered by plant residue to prevent further erosion. New seedings should be protected from grazing for 2 years. Deferred grazing and control of livestock numbers are needed on overgrazed pasture. Suitable sites for ponds are common on these soils. (Capability unit VIe–9, dryland; Thin Silty range site; Silty to Clayey woodland site)

Dawes Series

The Dawes series consists of deep, dark-colored, claypan soils of the uplands (fig. 24). These soils developed mainly in loess and are on nearly level slopes where surface drainage is poor. They occur chiefly on the South Table but are also in small areas on the North Table.

The surface layer is very dark grayish brown and is about 5 inches thick. It has a granular structure, is friable, and is leached of lime.

Beneath the surface layer, there is a 2-inch layer of dark-gray or dark grayish-brown silt loam that has been oxidized and leached of organic matter and clay minerals. The boundary between this layer and the subsoil is very abrupt.

The subsoil has two distinct parts, the upper subsoil and the lower subsoil. A compact layer of very dark brown silty clay, or claypan, makes up the upper subsoil. This layer is about 8 inches thick and is arranged in strong, medium columns that have distinctly rounded caps. When pressure is applied, these columns break into fine, angular blocks. This layer is free of lime; it is hard when dry and firm when moist. The lower subsoil is dark-brown silty clay loam about 5 inches thick. Moderate, medium prisms that break into moderate, fine and medium, angular blocks make up the structure. In some places this layer is free of lime. It is hard when dry and friable when moist.

The parent material is brown to pale-brown silt loam that is weakly prismatic in the upper part and is structureless in the lower part. This horizon, especially the lower part, contains a concentration of lime. It is very friable and is easily penetrated by roots.

The underlying material occurs at a depth of about 36 inches. It consists of mixed medium-sized and fine gravel that was deposited by water and is limy. Rodents have brought some of the gravel into the soil above.

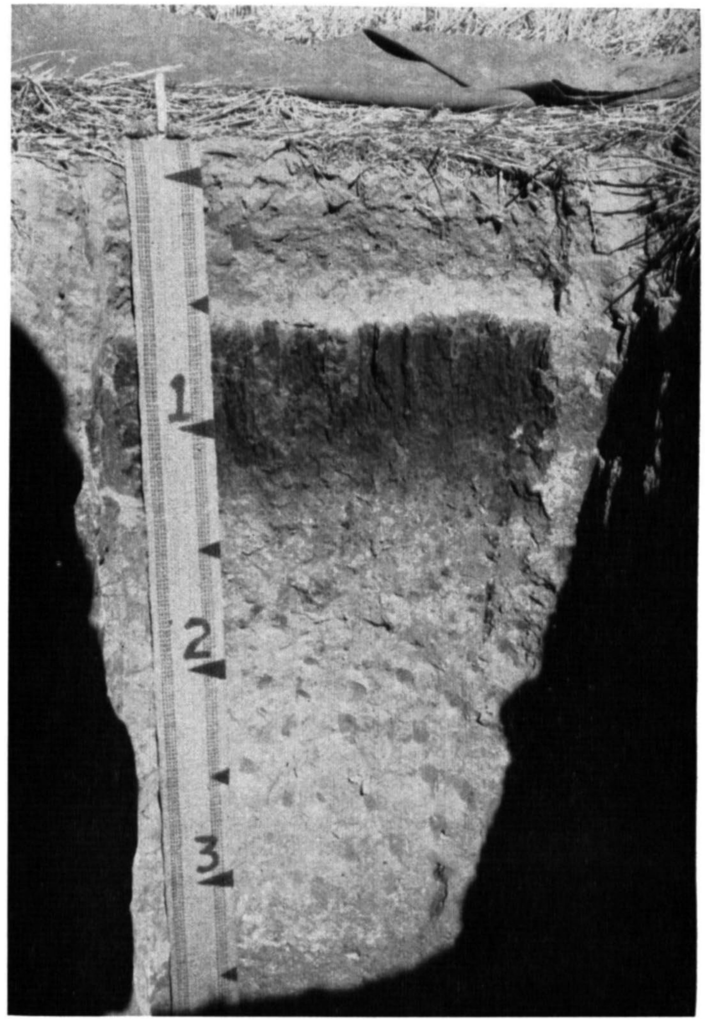

Figure 24.—**Profile of Dawes loam.**

The Dawes soils are more clayey, are less well drained, and have a more strongly developed subsoil than the Richfield, Keith, Kuma, and Rosebud soils. They are deep over gravel, whereas the Rosebud soils are moderately deep over limy sandstone. Dawes soils are better drained than Scott soils and have less clay in their subsoil.

The Dawes soils are fairly uniform in Deuel County. Their surface layer ranges from 4 to 8 inches in thickness. The compact claypan ranges from heavy silty clay loam to clay in texture. The lower subsoil is 3 to 8 inches thick. In some places the accumulation of lime is in the lower subsoil, but generally it is in the silty parent material. The depth of leaching ranges from 14 to 21 inches. In many places cultivation has destroyed the thin, gray, leached horizon beneath the surface layer.

The Dawes soils are moderately well drained. Permeability and surface runoff are slow. The soils are easily worked and normally have a high available water capacity, but they are droughty in dry years because the claypan limits the amount of moisture released to plants. Although the risk of washing is only slight, wind erosion is a hazard if a large area is left unprotected. Natural fertility is medium.

The Dawes soils are well suited to all dryland crops grown in the county. Nearly all the soils are cultivated, mainly to winter wheat.

Dawes-Keith loams, 0 to 1 percent slopes (DK).—This complex is the largest unit of Dawes-Keith loams in the county. It occurs on the upland tablelands, mainly on slopes of 0.5 percent or less. The largest areas are on the South Table. The complex is made up of soils of several series that occur in such intricate patterns that mapping the soils separately is impractical. It is about 60 percent Dawes loam, 20 percent Keith silt loam, 10 percent Kuma loam, and 10 percent Richfield silt loam.

Nearly all the acreage is cultivated. Although the soils are only slightly eroded, practices are needed to control wind erosion and to maintain or increase the intake of moisture. A suitable cropping system consists of wheat alternated with fallow. Residue should be kept on the surface during the fallow period. (Capability unit IIIs-2, dryland; Silty range site; Silty to Clayey woodland site)

Dawes-Keith loams, 1 to 3 percent slopes (DKA).—This complex is in very gently sloping areas that occur within the nearly level parts of the tablelands. Many of the areas are near the edges of the tablelands. About half are on the South Table, and the rest are scattered throughout the North Table. The areas are not extensive and average 10 to 15 acres in size.

This complex is 55 percent Dawes loam, 25 percent Keith silt loam, and 20 percent Richfield silt loam. The soils are so intermingled that they could not be mapped separately. Their surface drainage is better than that of Dawes-Keith loams, 0 to 1 percent slopes. About half the acreage has a surface layer that is only 4 inches thick.

Nearly all of this complex is cultivated; a few areas are in native grass. Although erosion is only slight, management is needed to prevent washing and blowing. Erosion can be controlled by keeping crop residue on the surface during the fallow period, by terracing and contour farming all sloping areas in crops, and by pasturing grassland properly. (Capability unit IIIe-2, dryland; Silty range site; Silty to Clayey woodland site)

Dix Series

Soils of the Dix series are shallow, gravelly, and excessively drained. They occur mainly on steep upland slopes and ridges made up of small gravelly mounds. They are at high elevations on the breaks between the silty tablelands and the deeply cut valleys of Lodgepole Creek and the South Platte River. (See fig. 4, p. 4.)

These soils have a very dark grayish-brown surface layer about 5 inches thick. It is granular, porous, very friable, and free of lime.

The subsoil is very dark grayish-brown gravelly loam about 12 inches thick. This layer has a coarse, subangular blocky structure and is free of lime. It contains more gravel and more clay than does the surface layer.

The material underlying the subsoil is light-colored sand and gravel that was deposited by water. This material is loose and structureless and is free of lime carbonate in the upper part. In some places it contains a little silt in the upper part. Roots do not easily penetrate this zone. Where the plant cover is native grass, roots are concentrated in the surface layer and subsoil.

The Dix soils are younger and shallower than the Altvan and Chappell soils and are more gravelly but less clayey in the subsoil. Although Dix soils occupy about the same positions as Canyon soils, they developed in water-deposited beds of sand and gravel instead of residual limy sandstone.

The surface layer of these soils ranges from 4 to 7 inches in thickness and from gravelly sandy loam to gravelly loam in texture. The subsoil ranges from weakly defined to well defined and is about 6 to 13 inches thick. In some places a transitional layer, as much as 3 inches thick, occurs between the subsoil and underlying material. The depth to stratified sand and gravel ranges from about 10 to 20 inches. The underlying gravel is normally free of lime in the upper part. In most places the lower layers of gravel contain pebbles coated with lime.

These excessively drained soils have rapid permeability. Surface runoff is only medium because much of the precipitation is absorbed. The available water capacity and natural fertility are low. These soils are not likely to wash or blow, because nearly all the acreage is in grassland. The soils are best suited to native grasses.

Dix complex, 5 to 20 percent slopes (DxD).—This complex is rolling to steep and occurs in irregularly shaped areas that range from a few to about 150 acres in size. About 60 percent of the complex is Dix gravelly loam; 30 percent is very shallow, gravelly soils that are like the Dix soils but are less than 10 inches deep; and 10 percent is Altvan and Chappell soils. These soils are in such an intricate pattern that they could not be mapped separately. Most areas are in native grass and are only slightly eroded, but small areas on lower slopes occur within cultivated fields and are moderately eroded.

These soils are not suitable for cultivation, because slopes are steep, the risk of water erosion is severe, and the available water capacity is low. They are best suited to native grass. Eroded areas should be seeded to a mixture of mid and tall grasses and then protected for two growing seasons. A good cover of grass can be maintained by proper stocking, deferred grazing, and other practices of management. (Capability unit VIs-41, dryland; Shallow to Gravel range site; Shallow woodland site)

Dix complex, 20 to 30 percent slopes (DxE).—This complex consists of dominantly very shallow soils that are steep but are only slightly eroded (fig. 25). The soils occur in areas that are irregular in shape, are a few to about 250 acres in size, and are generally larger than those

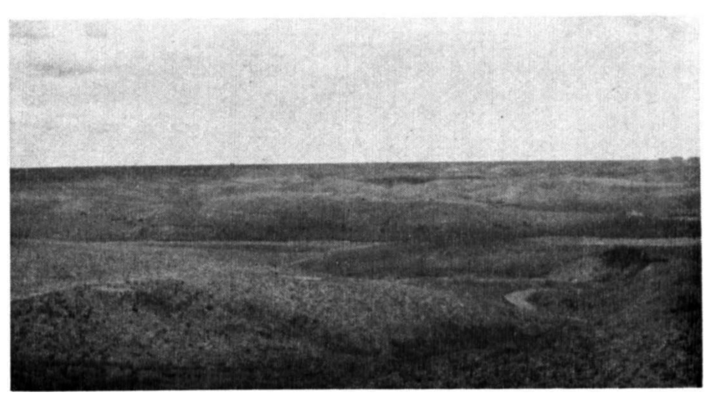

Figure 25.—Landscape of soils in the Dix complex.

Figure 26.—Profile of very shallow, gravelly soil in the Dix complex.

of the Dix complex, 5 to 20 percent slopes. About 40 percent of the complex is Dix gravelly sandy loam, and 60 percent is very shallow, gravelly soils that are like the Dix soils but are less than 10 inches deep (fig. 26). These soils are so intermingled that they cannot be mapped separately.

All of these soils are in native grass, which can be maintained by good management. Overgrazed pasture should be rested until a good cover of grass is reestablished. (Capability unit VIIs–3, dryland; Very Shallow Porous range site; no woodland site)

Dix-Chappell loams, 9 to 15 percent slopes (DCD).—This complex is about 50 percent Dix gravelly sandy loam, 30 percent Dix gravelly loam, and 20 percent Chappell and Altvan soils. It occurs in hilly areas below the steep Dix complex, where the soils are deeper and have a smoother surface.

Nearly all the acreage of this complex is in native grass and is only slightly eroded. Areas in crops and overgrazed pasture should be reseeded to a suitable mixture of native grasses. Keep livestock off new seedings for 2 years. Good management maintains or improves pasture. (Capability unit VIs–41, dryland; Shallow to Gravel range site; Shallow woodland site)

Dunday Series

The Dunday series consists of deep, sandy, excessively drained soils that have a surface layer darkened by organic matter. These soils occur on uplands and high terraces east of Lodgepole Creek, southeast of Chappell. They occupy low slopes and swales along the western edge of Valentine soils and within them. (See fig. 9, p. 7.)

These soils have a very dark grayish-brown surface layer about 8 inches thick. This layer has very fine, granular structure. It is free of lime, porous, and very friable.

The subsoil, about 5 inches thick, is dark grayish-brown or grayish-brown fine sand that is free of lime carbonate and is loose and structureless. The boundary between this layer and the parent material is gradual.

The parent material consists of brown fine sand that is loose and structureless and, like the layers above, is free of lime. It is easily penetrated by plant roots.

Dunday soils have a thicker, darker surface layer than Valentine soils, which occur on steeper slopes. Also, they are less sandy than Valentine soils. Dunday soils are more sandy and are less coherent than Anselmo soils.

The Dunday soils are fairly uniform in Deuel County. The surface layer ranges from about 6 to 11 inches in thickness and from loamy fine sand to fine sand in texture. In some places a layer of siltier material occurs at a depth of about 30 inches.

These excessively drained soils are rapidly permeable. Surface runoff is slow because most of the precipitation is absorbed. Natural fertility is low. The soils have low available water capacity, are droughty, and are easily eroded by wind, though water erosion is only a minor hazard.

Dunday soils are best suited to native grass. Most areas are in grasses, but a few small areas are cultivated.

Dunday loamy fine sand (Du).—This is the only Dunday soil in Deuel County. It occurs in only a few areas and covers only a small acreage. The largest areas are within and along the western edge of Valentine soils. Erosion is evident in fields now or recently cultivated.

Unless it is protected by a stubble mulch or by a good cover of grass, this soil is likely to blow severely. A suitable cropping system consists of small grain followed by grasses and legumes. Because the risk of wind erosion is severe, the soil should not be summer fallowed. (Capability unit IVe–5, dryland; Sandy range site; Sandy woodland site)

Goshen Series

Soils of the Goshen series are deep, very dark colored, and silty. They are on nearly level to very gentle concave slopes. These soils occur along narrow drainageways on the uplands and in well-drained swales or basins on the tablelands. They formed in wind-deposited loess mixed with colluvial-alluvial material that washed in or worked down from higher soils.

The surface layer is very dark brown and is about 17 inches thick. The 8-inch plow layer has fine, granular

structure and is very friable. In the lower 9 inches, the surface layer has weak, coarse, blocky structure.

These soils have a thick subsoil that is free of lime carbonate. The upper subsoil is silt loam or silty clay loam, is about 19 inches thick, and is very dark brown or very dark grayish brown. Its structure is moderate, coarse, and prismatic. When pressure is applied, the prisms break into fine and medium, subangular blocks. The upper subsoil is more compact than the lower subsoil; it is hard when dry but is friable when moist. The lower subsoil is light silty clay loam to silt loam that is about 20 inches thick and is very dark grayish brown or dark grayish brown. Weak, coarse prisms that break into weak, medium, subangular blocks make up the structure.

The parent material is dark-brown or brown silt loam that is structureless and is easily penetrated by roots. To a depth of 40 to 60 inches, this material normally is noncalcareous.

Goshen soils have a thicker and much darker surface layer and a more clayey subsoil than Bridgeport soils, and they are leached of lime. The dark-colored part of Goshen soils is thicker than that of Kuma, Keith, Richfield, and Rosebud soils. Also, lime is more deeply leached in Goshen soils.

The surface layer of the Goshen soils ranges from 10 to 24 inches in thickness and from silt loam to fine sandy loam in texture. The subsoil ranges from black to very dark grayish brown. Structure of the subsoil is weak to nearly strong, prismatic and subangular blocky.

The Goshen soils are naturally well drained and are moderately permeable. They receive moisture from higher areas, and their available water capacity is high. Surface runoff is slow. The soils are high in natural fertility and are easily worked. Erosion, mainly by wind, is a hazard.

Goshen soils are well suited to native grass and to all dryland crops grown in the county. They are mostly cultivated to winter wheat. None of the acreage is irrigated.

Goshen fine sandy loam, 0 to 3 percent slopes (Gf).—This soil is mainly in small areas of 3 to 15 acres that lie within and along the edges of the moderately sandy uplands in the northeastern part of the county. These areas are in swales that are covered by an accumulation of fine sandy loam washed or blown from adjacent sandy soils. Included with this soil are areas of Goshen soils with a loam or light loam surface layer.

A suitable cropping system for this soil consists of small grain 1 year and fallow the next. During the fallow period, stubble mulching is effective in controlling wind erosion, and chemicals or subsurface tillage can be used to control weeds. Sloping areas should be contour farmed. (Capability unit IIe-3, dryland; Overflow range site; Sandy woodland site)

Goshen silt loam, 0 to 1 percent slopes (Gh).—This soil is the most extensive of the Goshen soils and occurs over a wide area on the upland table. It occupies tracts of 5 to 160 acres that typically are long and narrow and generally are in positions that receive runoff from slightly higher soils. About 10 percent of the acreage mapped as this soil is Kuma silt loam.

This soil is well suited to small grain and sorghum. Although it is not eroded, terraces are needed to divert excess water from higher soils, and fields should be stubble mulched to control soil blowing during the fallow period. (Capability unit IIc-1, dryland; Overflow range site; Silty to Clayey woodland site)

Goshen silt loam, 1 to 3 percent slopes (GhA).—This soil is extensive on the upland tables. It occurs in long, narrow areas of 5 to 70 acres that receive runoff from higher soils nearby. These areas are narrower than those occupied by Goshen silt loam, 0 to 1 percent slopes, and the slopes are a little more irregular. Inclusions of Kuma silt loam make up a small part of the acreage.

All crops commonly grown in the county are well suited to this soil. In cultivated fields, erosion can be controlled by stubble mulching and using subsurface tillage during the fallow period, by farming slopes on the contour, and by grassing the waterways. Fertilizer is needed for highest crop yields. Soil tests and field trials will indicate the amounts needed. (Capability unit IIe-1, dryland; Overflow range site; Silty to Clayey woodland site)

Havre Series

The Havre series consists of light-colored, calcareous, medium-textured soils that formed in alluvial material and are well drained. These soils occur on high bottoms and low terraces along streams. The material has been only slightly changed by soil-forming processes, and it is stratified below the surface layer.

The Havre soils cover only a small acreage in Deuel County but are more extensive in Sedgwick County, Colorado, which adjoins this county on the south. In Deuel County the Havre soils are mapped with the Bridgeport soils as undifferentiated units. These units are described under the heading "Bridgeport Series."

Keith Series

In the Keith series are deep, dark-colored, silty soils that occur on uplands covered by loess. These soils occupy the silty tablelands (see fig. 2, p. 3) and are by far the most extensive soils in Deuel County. Slopes are nearly level to rolling.

The surface layer is very dark brown or very dark grayish brown and is about 11 inches thick (fig. 27). It has fine, granular structure in the upper part, or plow layer, and coarse, blocky structure in the lower part. The surface layer is noncalcareous and friable.

The subsoil is about 20 inches thick; it has the highest content of clay and is most compact in the upper part. In the upper subsoil, the color is very dark grayish brown to dark grayish brown, the texture is light silty clay loam, and the structure is weak, coarse, prismatic. The lower subsoil is dark grayish-brown to grayish-brown, calcareous silty clay loam or silt loam that has weak, coarse, prismatic structure.

The parent material consists of brown to pale-brown loess of silt loam or very fine sandy loam texture. It is structureless, friable, and high in content of lime carbonate. Roots penetrate this material easily.

The Keith soils are thicker than the Richfield soils and are not so clayey in the subsoil. They are not so dark or so deeply leached of lime as the Kuma and Goshen soils. Keith soils are more mature than Rosebud soils, which formed in mixed loess and limy sandstone instead of loess. The Keith soils are thicker than the Colby and Ulysses

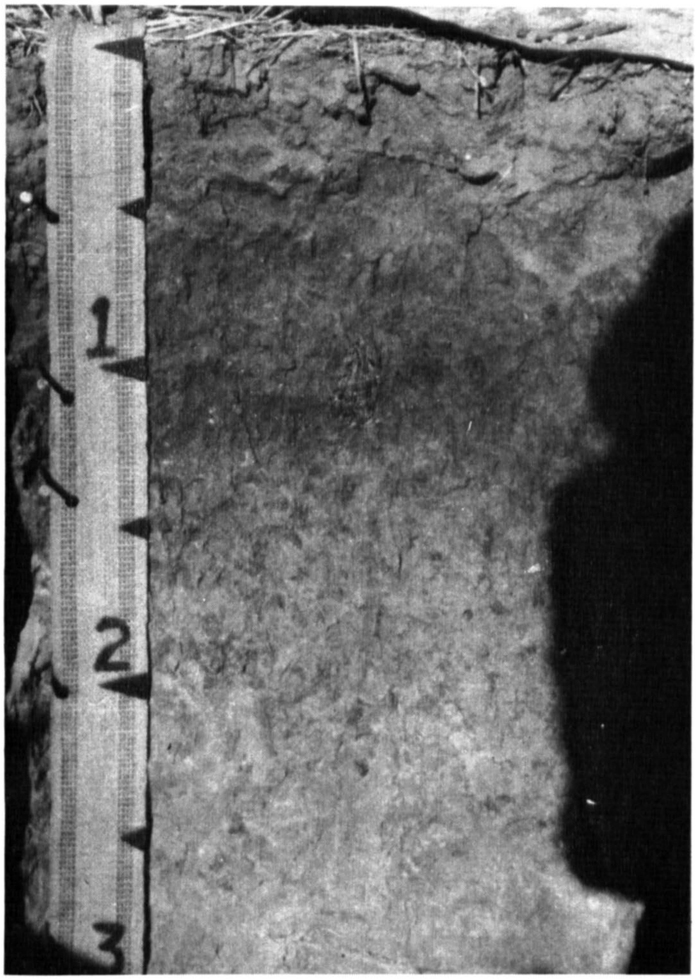

Figure 27.—Profile of Keith silt loam.

soils; they have a thicker and darker surface layer than those soils, and their zone of lime accumulation is deeper in the profile.

The surface layer of the Keith soils ranges from 6 to 12 inches in thickness and from silt loam to fine sandy loam in texture. In the less sloping areas, the subsoil ranges from silt loam to light silty clay loam, but in the more strongly sloping areas in the eastern part of the county, the subsoil is not so clayey. Areas that have a sandy surface layer are commonly light sandy clay loam or light clay loam in the subsoil. The subsoil ranges from 15 to 20 inches in thickness.

These soils are naturally well drained and have moderate permeability. They are high in natural fertility, are easily worked, and have high available water capacity, but they are susceptible to both wind and water erosion.

The Keith soils are well suited to winter wheat, to other dryland crops grown in the county, and to native grass. Most of the Keith soils are cultivated, chiefly to winter wheat.

Keith silt loam, 3 to 5 percent slopes (KeB).—This soil covers a large acreage in the county and occurs in areas of 5 to more than 80 acres on undulating slopes throughout the tablelands. Its surface layer is only slightly eroded and is 7 inches thick. The subsoil is silt loam or heavy silt loam. At a depth of 20 to 24 inches, there is free carbonate of lime. Included with this soil are a few small areas of eroded Keith silt loam; areas of Keith soils that have a loam surface texture; and a small acreage of Rosebud and Altvan soils.

A large part of this soil is cultivated; the rest is in native grass. A suitable cropping system consists of small grain alternated with fallow. Moisture can be conserved and erosion controlled by installing terraces, farming along the contour, using stubble mulch, and returning all residue to the soil. Apply fertilizer according to the needs indicated by field trials and soil tests. (Capability unit IIIe-1, dryland; Silty range site; Silty to Clayey woodland site)

Keith silt loam, 3 to 5 percent slopes, eroded (KeB2).—This soil is in areas of 5 to 100 acres or more. It occurs in positions like those of Keith silt loam, 3 to 5 percent slopes, but it covers more than twice the acreage of that soil, is on slopes that generally are more convex, and has a lighter colored surface layer because of the loss of organic matter through water erosion. The surface layer is only about 5 inches thick. The subsoil is silt loam or heavy silt loam, and there is free carbonate of lime at a depth of about 20 inches. Included with this soil are a few small areas of uneroded and of severely eroded Keith silt loam; a few small areas of Keith fine sandy loam; and areas of Keith soils with a loam surface layer. Also included, in some places, are areas of Rosebud and Altvan soils.

This soil is well suited to small grain and sorghum. Nearly all the acreage is cultivated, mainly to winter wheat. Erosion can be controlled if a system of terraces is installed, if slopes are farmed along the contour, if stubble mulch is used, and if all residue is returned to the soil. Fertilizer is needed and should be applied in amounts determined by field trials and soil tests. (Capability unit IIIe-1, dryland; Silty range site; Silty to Clayey woodland site)

Keith silt loam, 5 to 9 percent slopes (KeC).—This inextensive soil is in small, scattered areas that occur mainly in the northeastern part of the county. It has a slightly eroded surface layer about 6 inches thick and a subsoil of silt loam or heavy silt loam about 11 inches thick. Lime, which occurs at a depth of 14 to 18 inches, is nearer the surface in this soil than in Keith silt loam, 3 to 5 percent slopes. Also, surface runoff is more rapid. Inclusions consist of a few small areas of eroded Keith soils; areas of Keith soils with a loam surface texture; and small areas of Colby and Ulysses soils.

Nearly all of this soil is in native grass. Controlling water erosion and increasing yields are the chief problems. If the soil is left bare, wind erosion is a hazard in dry years. Areas used for pasture should be protected by a thick stand of grass. If the soil is cultivated, the management needed consists of terracing, farming on the contour, keeping the surface covered by growing crops or by crop residue, and returning all residue to the soil. (Capability unit IVe-1, dryland; Silty range site; Silty to Clayey woodland site)

Keith silt loam, 5 to 9 percent slopes, eroded (KeC2).—This soil accounts for only a small acreage in Deuel County, though it is more extensive than Keith silt loam, 5 to 9 percent slopes. It occurs mainly in the northeastern part of the county, where slopes generally are stronger than in other parts. This soil has lost about 40 percent of

its original surface layer, including much of the dark-colored organic matter, through water erosion. The remaining surface soil is only about 4 inches thick; it has been mixed with the top part of the subsoil through tillage and is lighter colored than the surface layer of uneroded Keith silt loam. The subsoil is about 11 inches thick and is silt loam or heavy silt loam. Lime occurs at a depth of 12 to 14 inches. Included with this soil are a few areas of severely eroded Keith soils and areas of Keith soils that have a very fine sandy loam or a loam surface layer. Also included is a small acreage of Colby and Ulysses soils.

This soil is well suited to small grain and to grass. Nearly all of it is cultivated. Terracing, farming along the contour, and keeping the surface covered by growing crops or by crop residue help to conserve moisture and to control erosion. Fertilizer should be applied as indicated by field trials and soil tests. (Capability unit IVe-1, dryland; Silty range site; Silty to Clayey woodland site)

Keith-Kuma silt loams, 0 to 1 percent slopes (KK).—This complex occurs in many parts of the tablelands. It is made up of soils that are in such an intricate pattern that it is impractical to show them separately on a map. Keith silt loam comprises 50 to 60 percent of the complex, and Kuma silt loam, 40 to 50 percent. Small areas of Goshen silt loam are included.

Areas of these soils occupy flats that range from a few to about 640 acres in size. They are slightly upslope from areas of Goshen soils and are slightly downslope from areas of Keith-Richfield soils. (See fig. 2 p. 3.) These soils have slow surface runoff and are subject to little or no erosion by water. Wind erosion is only a slight hazard.

Nearly all of this complex is cultivated, mainly to winter wheat. Soil blowing can be controlled by utilizing all crop residue and by keeping the surface covered with plants during winter. (Capability unit IIc-1, dryland; Silty range site; Silty to Clayey woodland site)

Keith-Richfield silt loams, 0 to 1 percent slopes (KR).—This complex occurs in many parts of the tablelands and is one of the largest units of soils in Deuel County. It is made up of about 60 percent Keith silt loam, 30 percent Richfield silt loam, and 10 percent Kuma silt loam. Small tracts of Goshen soils are included.

Areas of these soils occupy smooth slopes that are almost flat and are only slightly eroded. (See fig. 2, p. 3.) Most areas are large and continuous. Surface runoff is slow and causes little or no washing, but wind erosion is a hazard.

These soils are well suited to crops, and most of their acreage is cultivated. The principal crop is winter wheat, but winter barley, sorghum, and other dryland crops also are grown. A few small areas remain in native grass. In cultivated fields, the chief needs are to conserve moisture and to prevent wind damage. Applying fertilizer and keeping the surface covered by crop residue or by growing crops control wind erosion and maintain a balance between moisture and fertility. Grain stubble should not be burned. (Capability unit IIc-1, dryland; Silty range site; Silty to Clayey woodland site)

Keith-Richfield silt loams, 1 to 3 percent slopes (KRA).—This complex occurs throughout the silty tablelands and is the largest unit of soils in the county. About 62 percent of the complex is Keith silt loam, 35 percent is Richfield silt loam, and 3 percent is Kuma silt loam. Included are small tracts of Goshen and Rosebud soils.

Areas of these soils are mostly very large; they are larger and more nearly continuous than those of Keith-Richfield silt loams, 0 to 1 percent slopes. The soils occur on short slopes that are smooth but slightly wavy. (See fig. 2, p. 3.) Less than 10 percent of the acreage consists of soils on convex slopes with an eroded surface layer about 5 inches thick. Although surface runoff is slow, all the soils are susceptible to water erosion. Also, they are likely to blow if unprotected.

A few small areas of the complex are in native grass, but nearly all the acreage is cultivated. Winter wheat is the main crop and is well suited. Also grown are winter barley, sorghum, and other dryland crops. In cultivated fields, erosion can be controlled and moisture conserved by terracing, farming along the contour, keeping the surface covered by growing crops or crop residue, and using stubble mulch during the period of summer fallow. (Capability unit IIe-1, dryland; Silty range site; Silty to Clayey woodland site)

Keith and Tripp fine sandy loams, 0 to 3 percent slopes (KT).—This undifferentiated group of soils is the most extensive unit of Keith and Tripp fine sandy loams in Deuel County. It occurs mainly on the moderately sandy uplands (see fig. 9, p. 7), but there are a few areas scattered on other parts of the uplands. The unit occupies low ridges that generally are long and extend in a northwest-southeast direction, though some ridges, especially those east of the rolling sands, are about as broad as they are long. Surface runoff is slow and causes little or no erosion. The wind is a hazard, however, and has eroded the soils in some places.

A few areas of the unit are in native grass, but most of the acreage is cultivated, principally to winter wheat. Other crops grown are dryland corn and sorghum. Erosion can be controlled in cultivated fields by keeping all residue on the surface and by farming sloping areas on the contour. Fertilizer should be applied as indicated by field trials and soil tests. (Capability unit IIe-3, dryland; Sandy range site; Sandy woodland site)

Keith and Tripp fine sandy loams, 3 to 5 percent slopes (KTB).—This undifferentiated unit accounts for only a small acreage in the county. It occurs in a few small areas and is nearly all in native grass. The soils are slightly eroded. Surface runoff is medium but causes little erosion because the soils are protected. If the plant cover is disturbed, however, the risk of blowing is severe.

These are good soils for crops, but they need the protection of growing crops or crop residue to control wind erosion and to conserve moisture. Terracing and contour farming are other practices needed in cultivated fields. (Capability unit IIIe-3, dryland; Sandy range site; Sandy woodland site)

Keith and Tripp fine sandy loams, 3 to 5 percent slopes, eroded (KTB2).—This undifferentiated unit occurs in small areas. It is similar to Keith and Tripp fine sandy loams, 3 to 5 percent slopes, but its eroded surface layer is only about 5 inches thick. In addition, this layer has lost some of its fine particles and organic matter because of wind action. If cultivated and not protected, the soils are very susceptible to further erosion by wind. Because surface runoff is medium, it too is a hazard.

The soils of this unit are cultivated. The main crop

is winter wheat, but dryland corn and sorghum also are grown. Applying fertilizer and growing high-residue crops maintain or improve the tilth of the soil, the intake of moisture, the organic-matter content, and the yields of crops. (Capability unit IIIe-3, dryland; Sandy range site; Sandy woodland site)

Keith and Tripp fine sandy loams, 5 to 9 percent slopes, eroded (KTC2).—This undifferentiated group of soils makes up only a small part of the county. Most areas are eroded, but a few included areas are slightly eroded, and a few are severely eroded. Also included are areas of Anselmo soils, small areas of Keith silt loam, and a few small areas of Colby and Ulysses soils.

A few areas of this unit are in native grass, but most of it is cropped. The main crop is winter wheat. In cultivated fields, terracing and contour farming are needed to help control erosion. Keeping residue on the surface prevents blowing and increases the intake of water. Apply fertilizer according to the needs indicated by soil tests. (Capability unit IVe-3, dryland; Sandy range site; Sandy woodland site)

Kuma Series

In the Kuma series are deep, dark-colored, silty soils that occur on uplands mantled by loess. These soils occupy flat areas on the silty tablelands. (See fig. 2, p. 3.) They are underlain by dark-colored material that is the buried surface layer of an older soil.

These soils have a very dark brown or very dark grayish-brown surface layer about 11 inches thick. This layer has granular structure in the upper part and coarse blocky structure in the lower part. It is free of lime and friable.

The subsoil is a very thick layer of dark-colored, noncalcareous silty clay loam. The upper 8-inch part of the subsoil is dark grayish brown. Its structure consists of weak prisms that break into fine and medium, subangular blocks. The central, and main, part of the subsoil is a buried surface layer that is black, is about 15 inches thick, and is arranged in moderate, coarse prisms. When pressure is applied, the prisms break into moderate, fine and medium, subangular blocks. The lower subsoil is brown silt loam of weak, coarse, prismatic structure. It is about 13 inches thick and is transitional to the parent material.

The parent material consists of brown or pale-brown silt loam that was deposited by wind. It is structureless, contains much lime, and is easily penetrated by roots.

The Kuma soils have a darker and more strongly developed lower subsoil than the Keith soils and are leached to a greater depth. They are not so thick as Goshen soils, which lack a zone of lime enrichment. Kuma soils are thicker and darker than the Richfield soils but are not so strongly developed.

The subsoil of Kuma soils ranges from 2 to 3 feet in thickness. The dark-colored buried layer is 5 to 15 inches thick. Lime occurs at a depth of 3 to 4 feet. In some places there is underlying gravel at a depth of about 50 inches.

These soils are naturally well drained. They have moderate to moderately slow permeability. Runoff is slow. The available water capacity and natural feritlity are high. The soils are easily worked, though they are susceptible to wind erosion if unprotected.

The Kuma soils are well suited to winter wheat and to other dryland crops grown in the county. They are also well suited to native grass. Nearly all the Kuma soils are cultivated; winter wheat is widely grown. None of the acreage is irrigated.

In this county the Kuma soils occur closely with the Keith soils, and they are mapped only in a complex with those soils. This complex—Keith-Kuma silt loams, 0 to 1 percent slopes—is described under the "Keith Series."

Las Series

Soils of the Las series are deep, dark colored, imperfectly drained, and calcareous. These soils are on nearly level bottom lands along the South Platte River and Lodgepole Creek. (See fig. 8, p. 6.) They developed in loamy alluvial sediments and are underlain by sand or sand and gravel saturated with water.

The surface layer is black or very dark brown and averages about 10 inches in thickness. It has granular structure, is friable, and is generally calcareous. In some places it contains a moderate amount of soluble salts.

The parent material consists of several layers of moderately fine textured alluvial sediments that range from dark grayish brown to light gray. This material has coarse, prismatic structure or is structureless. It has a high content of lime, contains a moderate amount of soluble salts, and is moderately to strongly alkaline.

Underlying these soils at an average depth of 35 inches is light-colored sand or sand and gravel. This material is saturated with water, has brown stains of iron, is highly calcareous, and contains hard concretions of lime carbonate.

The Las soils are darker colored and more silty than the Las Animas soils and are deeper over sand and gravel. They contain more clay in their lower layers than do the Wann soils. The Las soils are not so saline or so alkaline as the Laurel soils and the land type, Slickspots.

The surface layer of Las soils ranges from black to very dark grayish brown in color and from 6 to 14 inches in thickness. The parent material ranges from 20 to 35 inches in thickness and varies greatly in stratification. It ranges from dark grayish brown to gray and from loam to silty clay loam. The depth to the underlying material ranges from 2½ to 4 feet. Generally, these soils are only slightly affected by salinity or alkalinity, but small areas are strongly affected. In some places the surface layer is noncalcareous in the upper few inches.

In these imperfectly drained soils, the water table is about 2½ to 4 feet below the surface. Surface runoff and permeability are slow. The available water capacity and natural fertility are high. The soils are easily worked but are susceptible to wind erosion if unprotected.

Las soils are well suited to cultivated crops and to native grass. Some areas are used for irrigated crops, mainly corn, and the remaining acreage is in native grass that is pastured or cut for hay. Most of the native meadow and hay along the north side of the South Platte River is on Las soils.

Las loam (Lt).—This soil is on the nearly level flood plains of the major streams. The largest areas are along the South Platte River, and there are smaller ones along

Lodgepole Creek. Most areas south of the river are used for irrigated crops, but many of those north of the river are in native meadow (fig. 28). Included with this soil are areas of Las Animas soils that make up about 10 percent of the acreage. Also included are a few small areas of Wann soils. Drainage is needed in wet areas of this soil. Fertility can be maintained by using fertilizer according to the needs indicated by field trials and soil tests. Mixtures seeded for hay or pasture should include a legume. (Capability unit IIw-4, dryland; IIw-4, irrigated; Subirrigated range site; Moderately Wet woodland site)

Las Animas Series

In the Las Animas series are nearly level or very gently sloping, moderately deep, imperfectly drained soils on bottom lands along the South Platte River and Lodgepole Creek. (See figs. 8 and 9, p. 6 and p. 7.) These soils are immature. They developed in sandy alluvial sediments containing an appreciable amount of gravel. They are calcareous and are underlain by water-bearing beds of sand and gravel.

The surface layer is very dark grayish brown and averages about 9 inches in thickness. It has granular structure, is very friable, and is high in content of lime carbonate.

Directly beneath the surface layer is alluvial parent material that consists of dark grayish-brown and grayish-brown gravelly loamy sand and sandy loam. This material is highly calcareous and is structureless but friable. In some places it is moderately akaline.

The underlying material is light-colored, mixed sand and gravel that occurs about 30 inches below the surface. Because it is saturated with water, this material restricts the penetration of plant roots.

Las Animas soils are lighter colored and sandier than the Las soils but are not so deep. They are similar to Wann soils but are shallower and contain more gravel in the lower part of the profile.

The surface layer is generally fine sandy loam or loamy sand but is loam in a few places. It ranges from 6 to 16 inches in thickness. The color is very dark brown in the fine sandy loam and is grayish brown in the loamy sand. The depth to loose sand and gravel ranges from 20 to 36 inches. Stratification varies greatly. In some places the soil has a loamy sand surface layer that is leached and is underlain by sand that contains only a little gravel. The alkalinity varies from slight to moderate.

These imperfectly drained soils have a water table that fluctuates between 1½ and 4 feet of the surface. Permeability is rapid, and surface runoff is slow. The soils, unless protected, are very susceptible to wind erosion. They are best suited to native grass, but some areas are cultivated under irrigation, mainly to corn.

Las Animas fine sandy loam (Lc).—The largest areas of this soil are on the flood plain of the South Platte River. Also, this soil makes up most of the narrow strip of bottom land along Lodgepole Creek. Included are small areas of Las and Wann soils and a few small areas that have a loam surface layer. More than half the acreage is in native grass, and the rest is used as irrigated cropland, all of which occurs along the river. The main crop is corn.

This soil is kept fertile and in good tilth by returning all residue to the soil and by using fertilizer according to needs indicated by field trials and soil tests. Wet areas should be drained. (Capability unit IVw-5, dryland; IIIw-6, irrigated; Subirrigated range site; Moderately Wet woodland site)

Las Animas loamy sand (Lw).—This inextensive soil is mainly on slightly convex slopes and occurs in small areas next to the South Platte River. In many respects it is similar to Las Animas fine sandy loam, but it is less coherent than that soil and is slightly more stratified and variable throughout. In some places the lower part of the soil is stratified and sandy and contains only a little gravel. Included are a few areas with a fine sandy loam surface layer.

Most of this soil is in native grass. A few small areas are used for irrigated crops, principally corn. Unless protected by a growing crop or by crop residue, the soil is susceptible to wind erosion. To maintain crop yields, fertilizer is needed. Wet areas should be drained. (Capability unit IVw-5, dryland; IVw-5, irrigated; Subirrigated range site; Moderately Wet woodland site)

Figure 28.—**Baled hay cut from native grass on Las soils, bottom land of the South Platte River.**

Laurel Series

The Laurel series consists of dark-colored, poorly drained, alkali soils that developed in fine-textured alluvial sediments. These soils occur in small areas on the bottom lands of Lodgepole Creek and the South Platte River. (See fig. 8, p. 6.) Their surface is nearly level and slightly concave.

Laurel soils have a very dark brown surface layer about 12 inches thick. It has a granular structure and is friable in the upper part; in the lower part it has coarse, blocky structure. The surface layer contains much lime and is strongly akaline.

The subsoil is a thin transitional layer between the surface layer and the parent material. It is very dark and is moderately fine textured. It has coarse, blocky structure and is hard, calcareous, strongly alkaline, high in soluble salts and sodium, and slowly permeable.

The parent material consists of stratified layers that are fine textured and are black to dark grayish brown. This

material is hard, structureless, highly calcareous, strongly alkaline, and slowly permeable. It contains moderate amounts of soluble salts.

These soils are underlain by light-colored, loose sand and gravel at a depth of 45 inches or more.

Compared to the Nunn and Las soils, the Laurel soils are finer textured, higher in sodium content, more highly alkaline, and less well drained. In addition, Laurel soils are more stratified and more variable in other features.

The surface layer ranges from black to dark grayish brown in color and from 6 to 16 inches in thickness. In some places the transitional layer between the surface horizon and the parent material is lacking. The stratified parent material ranges from black to gray and from clay to loam. In a few places it has thin strata of sandy loam or loamy sand between finer textured material. The amounts of soluble salts and sodium vary from place to place but are large enough to injure vegetation, and in places only the plants most tolerant of salts and alkali survive.

In these poorly drained soils, the water table fluctuates between 1 and 3 feet of the surface. The high sodium content causes poor structure of the soil and reduces permeability. Internal drainage, permeability, and surface runoff are slow. Because the soils are fine textured, they release water slowly to plants and are droughty.

The Laurel soils are best suited to salt- and alkali- tolerant grasses. Most areas are in native grass, dominantly saltgrass. A few areas are used for producing sugar beets under irrigation, but even where management is excellent, yields are low.

Laurel soils (LS).—This is the only unit of Laurel soils in the county. The soils occupy only a small acreage and are in the most poorly drained areas along the South Platte River. Overgrazed pasture and fields formerly in crops can be improved by planting salt-tolerant grasses. Some areas are suitable for hay. (Capability unit VIs–1, dryland; VIs–1, irrigated; Saline Subirrigated range site; no woodland site)

Nunn Series

The Nunn series is made up of deep, dark, silty soils that occur on low, nearly level stream terraces and are moderately well drained. (See fig. 8, p. 6.) The soils developed in moderately fine textured alluvium that contains small amounts of sodium and soluble salts.

The surface layer is very dark grayish brown to very dark brown, is about 11 inches thick, and is noncalcareous. The 7-inch plow layer has granular structure and is friable. In the lower 4 inches, the structure is weak, medium, subangular blocky.

The subsoil is very dark grayish-brown silty clay loam, as much as 40 inches thick. It is compact and has coarse, prismatic structure. Free lime occurs at a depth of about 20 inches. In places the content of soluble salts and sodium is moderately high.

The parent material occurs at a depth of about 50 inches. It consists of a grayish-brown silt loam that is structureless and highly calcareous.

The Nunn soils are on terraces lower than the Tripp and the Keith soils. Compared to these soils, the Nunn soils are thicker, have a more clayey subsoil, are less well drained, and contain some soluble salts and sodium. Nunn soils are thicker and better drained than Slickspots and are less saline and less alkaline.

The surface layer is generally silt loam but is loam in a few places. It ranges from 8 to 16 inches in thickness. The subsoil ranges from silty clay loam to clay loam and is 15 to 40 inches thick. It varies in compactness but is most compact and contains the most clay in the upper part. In some places there is an underlying layer of calcareous alluvial material that is somewhat sandy.

These moderately well drained soils have moderate to slow permeability and slow surface runoff. The available water capacity and natural fertility are high, but the soils are susceptible to wind erosion unless protected.

The Nunn soils are well suited to the irrigated crops grown in the county. Almost all the cultivated acreage is irrigated. Corn, alfalfa, and sugar beets are the principal crops.

Nunn silt loam (Na).—This slightly eroded soil is the most extensive soil in the Nunn series. The largest areas are south of the South Platte River, near Big Springs, where corn is grown under irrigation. Included are small areas of Tripp soils. (Capability unit IIc–1, dryland; I–1, irrigated; Silty range site; Silty to Clayey woodland site)

Nunn-Slickspots complex (NS).—This complex is inextensive in the county and consists of alkali and nonalkali soils that occur in the irrigated area southwest of Big Springs. It is 50 to 70 percent Nunn soils and is 30 to 50 percent Slickspots, which are small areas of saline-alkali soil. The Slickspots occur throughout the complex. The soils are generally droughty, though at one time they probably were affected by a high water table built up by seepage from irrigation ditches. At present the water table is lower.

If they are managed well, the Nunn soils and Slickspots of this complex are well suited to irrigated crops but not to crops under dryland farming. They also are well suited to salt- and alkali-tolerant grasses. (Capability unit IVs–1, dryland; IIIs–1, irrigated; Silty range site; Moderately Saline-Alkali woodland site)

Richfield Series

The Richfield series consists of deep, dark-colored, well-developed soils that formed on uplands in wind-deposited material. These soils occur on the silty tablelands and are nearly level or very gently sloping. (See fig. 2, p. 3.)

The surface layer is very dark grayish brown and is about 6 inches thick. It has a granular structure and is friable.

The subsoil is very dark grayish-brown silty clay loam about 17 inches thick. Moderate, coarse blocks and prisms that break into moderate, fine and medium, subangular blocks make up the structure. In the lower 5 inches, the subsoil is dark grayish-brown silt loam that has weak, coarse, prismatic structure. The subsoil is free of lime carbonate.

The parent material consists of pale-brown silt loam that is structureless and contains much carbonate of lime. Plant roots easily penetrate this horizon.

Richfield soils are similar to Keith soils but have more distinct horizons and contain more clay in the subsoil. They are not so dark or so deeply leached of lime as the Kuma and Goshen soils. Richfield soils are more mature

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than Rosebud soils, which formed in mixed loess and limy sandstone rather than loess.

The surface layer of the Richfield soils ranges from 5 to 8 inches in thickness and from silt loam to loam in texture. The subsoil ranges from very dark brown to dark grayish brown and is 12 to 19 inches thick. The subsoil ranges from silty clay loam to clay loam in the upper part and from silty clay loam to silt loam in the lower part. The lower part is transitional to the parent material and, in some places, is calcareous.

The Richfield soils are naturally well drained and are moderately permeable. They are high in available water capacity, are high in natural fertility, and are easily worked. The soils are subject to only slight water erosion because runoff is slow. They are more susceptible to wind erosion.

These soils are well suited to winter wheat, to other dryland crops grown in the county, and to native grass. Nearly all of the Richfield soils are cultivated, principally to winter wheat. Richfield soils are not irrigated.

In this county these soils occur closely with the Keith soils and are mapped only in complexes of Keith-Richfield silt loams. These mapping units are described under the heading "Keith Series."

Rosebud Series

The Rosebud series consists of deep and moderately deep, well-drained, loamy soils on upland slopes that are mostly undulating but range from nearly level to hilly. These soils occur mainly on the silty tablelands. (See fig. 2, p. 3.) They developed chiefly in highly calcareous residuum of sandstone and partly in windblown material, or loess.

These soils have a very dark grayish-brown surface layer about 6 inches thick. It is granular and friable.

The subsoil is about 18 inches thick. It is very dark grayish-brown clay loam in its upper part and is dark grayish-brown, limy loam in its lower part. In the upper 8 inches, the moderate prisms of the structure break to moderate, medium-sized, rounded blocks. The lower part has weak, prismatic structure. When pressure is applied the prisms break to weak, coarse, rounded blocks. The subsoil is firm to friable when moist.

The parent material is brown, loamy, highly calcareous, structureless, and friable. Plant roots easily penetrate this layer.

The underlying material is a weakly consolidated mass of limy sandstone that is pink to white. This material generally occurs at a depth of 20 to 50 inches. It varies in degree of hardness but cannot be penetrated by plant roots.

The Rosebud soils are slightly more sandy than the Keith or Richfield soils but are not so deep or so mature. In addition, Rosebud soils formed in mixed loess and residuum of limy sandstone, but Keith and Richfield soils formed entirely in loess. The Rosebud soils are deeper over limy sandstone than the Canyon soils.

The surface layer of the Rosebud soils ranges from about 5 to 11 inches in thickness and from fine sandy loam to loam in texture. In some places the subsoil is a transitional layer between the surface layer and the parent material and is only 4 to 10 inches thick. Although the limy sandstone generally occurs at a depth of 20 to 50 inches, in some places it is missing below the Rosebud fine sandy loams.

These soils are naturally well drained. They have moderate permeability and high available water capacity. They are easily worked. Natural fertility is medium. The soils are susceptible to both wind and water erosion.

The Rosebud soils on low slopes are well suited to winter wheat. They are also well suited to other dryland crops grown in the county and to native grass. A large part of the acreage is cultivated, mainly to winter wheat. None of the acreage is irrigated.

Rosebud fine sandy loam, 3 to 5 percent slopes (RdB).—This is a deep, uneroded soil that covers only a small acreage in the county. Most of it is in native grass. Included are areas of moderately deep Rosebud fine sandy loam that make up about 15 percent of the acreage. Also included are a few areas of Rosebud loam and of Keith and Tripp fine sandy loams.

If cultivated, this soil is subject to blowing and washing. Erosion can be controlled by stubble mulching and by keeping the soil covered in winter. Apply fertilizer according to the needs indicated by soil tests and field trials. (Capability unit IIIe-3, dryland; Sandy range site; Sandy woodland site)

Rosebud fine sandy loam, 3 to 5 percent slopes, eroded (RdB2).—This deep soil accounts for only a small acreage in the county. All of it is in crops. The surface layer has been thinned by wind and water erosion and is only 4 to 6 inches thick. Included are areas of moderately deep Rosebud fine sandy loam that make up about 15 percent of the acreage mapped as this soil. Also included are a few severely eroded areas, a few areas of Rosebud loam, and a few of Keith and Tripp fine sandy loams.

Erosion can be controlled and moisture conserved by growing crops that produce a large amount of residue, by using a stubble mulch, and by returning all residue to the soil. A well-designed system of terraces can be used to help control erosion in some areas. (Capability unit IIIe-3, dryland; Sandy range site; Sandy woodland site)

Rosebud fine sandy loam, 5 to 9 percent slopes (RdC).—This deep, uneroded soil is similar to Rosebud fine sandy loam, 3 to 5 percent slopes. It has only a small total acreage and is all in native grass. Inclusions of moderately deep Rosebud fine sandy loam make up about 20 percent of the acreage. Also included are a few small areas of Anselmo fine sandy loam and of Rosebud loam.

This soil is best used for close-growing crops or for pasture. To control erosion, the surface should be covered at all times. Apply fertilizer as indicated by soil tests or field trials. (Capability unit IVe-3, dryland; Sandy range site; Sandy woodland site)

Rosebud fine sandy loam, 5 to 9 percent slopes, eroded (RdC2).—This soil accounts for only a small acreage in Deuel County. It is a deep soil that is cultivated and has lost more than 25 percent of the original surface layer through erosion. Included with it are some severely eroded areas where all of the original surface layer has been removed. Also included are moderately deep areas that occupy about 20 percent of the acreage and a few small areas of Anselmo fine sandy loam and of Rosebud loam.

If this soil is cultivated, it needs a continuous cover of growing crops or crop residue to control erosion. (Capa-

bility unit IVe-3, dryland; Sandy range site; Sandy woodland site)

Rosebud loam, 0 to 3 percent slopes (RbA).—This soil is nearly level or very gently sloping and is only slightly eroded. Its surface layer is about 8 inches thick. The subsoil is thicker, more clayey, and better developed than the subsoil of other Rosebud soils and is underlain by bedrock at an average depth of 30 to 34 inches. This soil occurs with Keith and Richfield soils, and a few small areas of these soils are included in the acreage mapped. Also included are a few small areas that are moderately eroded.

Nearly all of this soil is cultivated, chiefly to winter wheat. Because surface runoff is slow, water erosion is only a minor problem, but stubble mulching is needed to control wind erosion, and sloping areas should be contour farmed. (Capability unit IIIe-1, dryland; Silty range site; Silty to Clayey woodland site)

Rosebud loam, 3 to 5 percent slopes (RbB).—This is a moderately deep soil that is uneroded and covered with native grass in most places. It occupies areas that range from a few to 40 acres in size and occur as low, isolated ridges. In some places the subsoil is only weakly developed.

Because water runs off this soil at a moderate rate, practices are needed to control erosion. In cultivated fields, keep the soil covered by growing crops or by crop residue. In grass pasture, good management is needed. (Capability unit IVe-1, dryland; Silty range site; Silty to Clayey woodland site)

Rosebud loam, 3 to 5 percent slopes, eroded (RbB2).—This moderately deep soil occupies areas throughout the tablelands and is the most extensive Rosebud soil in the county. These areas range from a few to more than 40 acres in size. Most of them occur as low, isolated ridges. Nearly all the acreage is used for crops and has an eroded surface layer only 4 to 6 inches thick. Because organic matter has been lost through wind and water erosion, the surface soil is slightly lighter in color than that of uneroded Rosebud soils. In some places the soil has a weakly developed subsoil. In most places many fragments of bedrock are scattered on the surface. Runoff is medium in areas where limy bedrock occurs near the surface. Included with this soil are a few small areas of Keith soils.

The main crop grown on this soil is winter wheat. Erosion can be controlled by terracing, farming along the contour, stubble mulching, and returning all residue to the soil. Fertilizer is needed and should be applied in amounts determined by field trials and soil tests. (Capability unit IVe-1, dryland; Silty range site; Silty to Clayey woodland site)

Rosebud-Canyon complex, 5 to 9 percent slopes (RCC).—This complex consists of uneroded soils that are in such an intricate pattern that it is not practical to map them separately. It occurs in small areas that generally lie along upland drainageways and along the breaks of Lodgepole Creek and the South Platte River. The complex is about 45 to 65 percent Rosebud soils and 20 to 40 percent Canyon soils. The surface layer of the Rosebud soils is loam in most places. Small areas of Keith and Altvan soils are included.

All the acreage is in native grass. (Capability unit IVe-1, dryland; Silty range site; Silty to Clayey woodland site)

Rosebud-Canyon complex, 5 to 9 percent slopes, eroded (RCC2).—The soils in this complex generally occur on slopes next to drainageways. They are cultivated and are eroded, mainly by water. About 45 to 65 percent of the complex is Rosebud soils and about 20 to 40 percent is Canyon soils. Included are small areas of Keith and Altvan soils.

These soils are best suited to native grass and should be reseeded to grass if possible. The grass can be used for hay or pasture. In cultivated fields, keeping the surface covered by growing crops or by stubble mulch controls erosion and maintains good structure. (Capability unit IVe-1, dryland; Silty range site; Silty to Clayey woodland site)

Rosebud-Canyon complex, 9 to 15 percent slopes (RCD).—This complex has a small total acreage in Deuel County. It is on the breaks above drainageways, where the slopes are too steep for cultivation and are covered with native grass. Rosebud soils account for about 40 to 60 percent of the complex, and Canyon soils make up about 25 to 45 percent. Small areas of Dix soils are included. All of the soils are so intermingled that they could not be mapped separately.

Because slopes are steep, these soils have rapid surface runoff and are susceptible to erosion. Washing can be prevented by keeping the soils protected with a good cover of grass. Areas now in crops should be seeded to grass, which can be used for hay or pasture. (Capability unit VIe-1, dryland; Shallow Limy range site; Silty to Clayey woodland site)

Sandy Alluvial Land (Sx)

Sandy alluvial land is a land type that consists of sandy and gravelly soils mapped together on uplands. It occurs in intermittent drainageways and on small fans at their mouth (fig. 29). The soils are noncalcareous, high in content of gravel, excessively drained, and generally very shallow. They are dry most of the time but are occasionally flooded by runoff from rainstorms or melting snow.

Unlike Wet alluvial land and its loamy strata, Sandy alluvial land generally has a thin, slightly darkened surface layer and is not affected by a high water table.

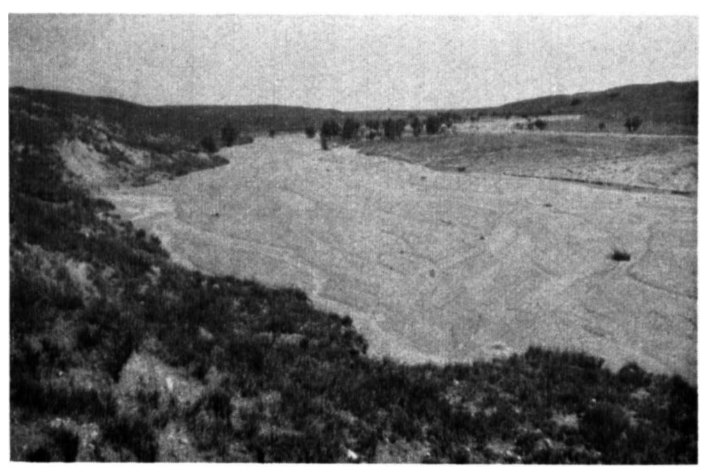

Figure 29.—Landscape of Sandy alluvial land.

The main channels of this land type are bare, but most of it is under a sparse growth of native plants used for pasture. (Capability unit VIs–41, dryland; Shallow to Gravel range site; no woodland site)

Scott Series

Soils of the Scott series are dark colored, clayey, and slowly permeable. They are on the silty tablelands (see fig. 2, p. 3) and occupy undrained depressions, or potholes, where water from rain and melting snow accumulates and slowly disappears through seepage or evaporation. These soils developed in loess or loesslike material.

The Scott soils have a very dark brown surface layer about 7 inches thick. This layer is either cloddy or has weak, fine, granular structure. It is slightly hard when dry but is friable when moist.

In most places a thin, very dark gray layer of silt loam is abruptly between the surface layer and the subsoil. This layer has been oxidized and leached of organic matter and clay minerals. It is generally 1 or 2 inches thick.

The subsoil is a claypan of very dark gray silty clay, about 30 inches thick. It is noncalcareous and is firm when moist. Because this layer is very slowly permeable, water often stands on the soil surface for a long time.

The parent material is brown loam that is structureless and noncalcareous.

Beneath the parent material is residuum of the sandstone that underlies most of the soils on tablelands in the county. This residuum is structureless, yellowish-brown sandy loam. The thick claypan above prevents all except a few plant roots from reaching this underlying material.

Scott soils are darker colored, finer textured, and more poorly drained than Dawes soils. They have a much thicker claypan subsoil than Dawes soils and are free of lime.

The surface layer ranges from 3 to 8 inches in thickness and from silty clay loam to loam in texture. The thin, oxidized, gray layer between the surface layer and the subsoil is as much as 3 inches thick, but in some places it is missing, and in places it is indistinct. In thickness the claypan subsoil ranges from 2 to more than 6 feet.

Scott soils have poor natural drainage. They are slowly permeable and are ponded for long periods in spring. After drying, they are susceptible to wind erosion. The soils are high in natural fertility, but they release moisture slowly to plants and are droughty.

Most areas of the Scott soils are cultivated because they occur within large areas of other soils. They are suited only to crops that can be planted late in spring after the soils dry out. Forage crops are grown in some of the larger areas of Scott soils.

Scott silty clay loam (Sc).—This is the only Scott soil in Deuel County. It is uneroded, is nearly level or very gently sloping, and occurs in many areas scattered throughout the tablelands. The areas average from 3 to 5 acres in size but range from 1 to 80 acres. Included are a few areas with a surface layer of silt loam.

If possible, drains should be installed in wet areas to carry away any excess water. Wind erosion is prevented in winter by keeping the soil covered by crops or crop residue. (Capability unit IIIw–2, dryland; Overflow range site; Moderately Wet woodland site)

Slickspots (Ss)

Slickspots consist of deep, moderately to strongly saline-alkali material that has had little development. They occur in areas of 10 to more than 100 acres that are scattered on the high bottoms of the South Platte River and Lodgepole Creek. The material contains excessive salts and sodium that accumulated through the rise and the evaporation of saline ground water. Because the concentration of sodium is strong, the structure of the soil is poor.

The surface layer of Slickspots is very dark grayish brown, about 6 inches thick, granular in structure, and friable. The subsoil is very dark brown to dark grayish-brown silty clay loam to clay loam, about 13 inches thick. Moderate, coarse prisms make up the structure. The subsoil is friable when moist but is hard when dry.

The parent material consists of sandy loam to silty clay loam that is high in content of sodium and soluble salts. The salts are concentrated in small, scattered, white spots and are commonly visible without a magnifying lens. Because of the strong salinity and alkalinity, few roots penetrate this horizon.

Slickspots are better drained than the Laurel soils and less saline. They are more poorly drained than Nunn soils and more saline and alkaline.

The surface layer is silt loam or heavy loam in texture and ranges from 5 to 8 inches in thickness. In some places there are thin, gray layers between the surface layer and the subsoil. The subsoil ranges from 10 to 15 inches in thickness. Throughout the soil material the concentrations of salts and of sodium vary from moderate to strong. Small spots that contain very large amounts of sodium cover 5 to 10 percent of the surface.

This land type is somewhat poorly drained. Permeability and surface runoff are slow. Erosion is not a serious hazard. Slickspots release moisture slowly to plants and are droughty. They are medium in natural fertility, but because they are saline-alkali, they are best suited to crops that tolerate salts and alkali.

Most of the acreage is in native grass. Along Lodgepole Creek and the South Platte River, however, fairly large areas are cropped under irrigation. The principal crops are corn, alfalfa, and mixtures of alfalfa and tall wheatgrass. (Capability unit VIs–1, dryland; IVs–1, irrigated; Saline-Subirrigated range site; no woodland site)

Tripp Series

The Tripp series consists of deep, dark, silty soils that are well drained and have a zone of lime accumulation. These soils are on nearly level or very gently sloping terraces, mainly along the South Platte River and Lodgepole Creek and on the mixed loess- and sand-covered uplands. (See fig. 4, p. 4, and fig. 8, p. 6.) They developed in old, silty alluvium to which loess has been added.

The surface layer of these soils is very dark grayish brown and is about 12 inches thick. It has a granular structure and is friable. Lime carbonate has been leached from this layer.

The subsoil is very dark grayish-brown to dark grayish-brown loam about 24 inches thick. It has coarse, prismatic structure and is calcareous in the lower part.

The parent material consists of dark grayish-brown, calcareous light loam. It is friable, structureless, and easily penetrated by roots.

The Tripp soils contain more sand but less silt and clay than the Keith soils and have less well defined horizons. They are deeper than Cheyenne soils and have silty instead of sandy and gravelly underlying material. Although the Tripp soils are in positions similar to those of the Bayard soils, they are more silty and are better developed than the Bayard soils. They occur with Bridgeport and Havre soils but are darker colored, more silty, and better developed than those soils.

The surface layer of Tripp soils ranges from about 7 to 14 inches in thickness and is silt loam or loam. The subsoil is about 15 to 30 inches thick and is loam or silt loam. A zone of lime accumulation generally occurs in the lower subsoil, but in some places it is in the upper part of the silty parent material. In places the Tripp soils are underlain by coarser sediments.

These well-drained soils are moderately permeable. They are high in natural fertility, have high available water capacity, and are easily worked. Surface runoff is slow, but wind erosion is a problem where the soils are not protected.

The Tripp soils are well suited to irrigated and dryland crops and to native grass. Nearly all the acreage is cultivated; about half is irrigated. The main crops are winter wheat under dryland farming and corn, alfalfa, and sugar beets under irrigation. Only a few small areas are in native grass.

Tripp-Keith silt loams, 0 to 1 percent slopes (TK).—This complex occurs in only a few areas in the county, but some are more than 160 acres in size. The complex is about 60 to 80 percent Tripp silt loam and 15 to 25 percent Keith silt loam. In about 15 percent of the acreage the Tripp soils are very deep and contain a buried soil that is thick and dark colored. Also in the complex are a few small areas of Cheyenne soils.

The soils of this complex are good for irrigation and are suited to all crops grown in the county. To control erosion and maintain fertility, use stubble-mulch farming and apply fertilizer according to needs indicated by field trials and soil tests. (Capability unit IIc–1, dryland; I–1, irrigated; Silty range site; Silty to Clayey woodland site)

Tripp-Keith silt loams, 1 to 3 percent slopes (TKA).—This complex is slightly higher than Tripp-Keith silt loams, 0 to 1 percent slopes, and has a smaller total acreage. It is more susceptible to erosion, though it is only slightly eroded. About 50 to 70 percent of the acreage is Tripp silt loam, and 25 to 40 percent is Keith silt loam. Included are areas of Cheyenne soils.

About half of this complex is irrigated. (Capability unit IIe–1, dryland; IIe–1, irrigated; Silty range site; Silty to Clayey woodland site)

Ulysses Series

The Ulysses series consists of deep, weakly developed, silty soils that formed in thick deposits of loess on uplands. These soils occupy high ridges and other sloping areas mostly in the northeastern part of the county. Slopes are chiefly rolling or hilly but are undulating in places.

The surface layer is 6 inches thick and is very dark grayish brown. It has granular structure, is soft when dry, and is very friable when moist. Except in cultivated areas, this layer is free of lime.

The subsoil is generally transitional between the surface layer and the parent material. This is a limy layer of silt loam that is about 5 inches thick and has weak, prismatic structure. This layer is soft when dry and very friable when moist, and it is easily penetrated by roots.

The parent material consists of light-colored very fine sandy loam that was deposited by wind and is high in content of lime carbonate. It is weakly prismatic in the upper part and is structureless in the lower part. It is soft when dry, very friable when moist, and easily penetrated by roots.

The Ulysses soils have the same kind of parent material as the Keith soils, but their surface layer is not so thick, and their subsoil is not so dark or so well developed. Ulysses soils are darker than the Colby soils and are leached to a slightly greater depth.

The surface layer of Ulysses soils ranges from 5 to 10 inches in thickness and, when moist, from very dark grayish brown to dark grayish brown in color. Although the subsoil is generally transitional between the surface layer and the parent material, in some places it is a weakly developed horizon. The depth to lime carbonate ranges from 5 to 15 inches.

The natural drainage of these soils is excessive. Permeability is moderate. Because slopes are steep in most places, the soils have rapid surface runoff and are very susceptible to water erosion where not protected. Their erodibility is increased by a low content of organic matter and a correspondingly low aggregation. The soils have high available water capacity but are droughty because much moisture is lost through runoff. Natural fertility is low.

The Ulysses soils are best suited to native grass. Most areas are in grass, but small areas in fields of more productive soils are cultivated. The main crop is winter wheat.

All the Ulysses soils in Deuel County occur closely with the Colby soils in mapping units that are complexes of Colby-Ulysses silt loams. These mapping units are described under the heading "Colby Series."

Valentine Series

Soils of the Valentine series occur on undulating to steep, hummocky slopes of the uplands and are deep, light colored, and sandy. They are the major soils on the rolling sands (see fig. 9, p. 7), and they also occupy small areas on the more strongly sloping parts of the moderately sandy uplands. Slopes range from 3 to more than 30 percent.

These soils have a dark grayish-brown surface layer that is about 5 inches thick and has weak, granular structure. It is noncalcareous, loose, and very porous (fig. 30).

Underlying the surface layer is parent material of brown fine sand that is thick, noncalcareous, loose, structureless, and very porous. It is easily penetrated by roots.

The Valentine soils are lighter colored, more sandy, and less coherent than the Anselmo soils. They are steeper and slightly more sandy than Dunday soils and have a thinner surface layer.

The darkened surface layer ranges from about 1 to 7 inches in thickness and is loamy sand or fine sand. Its

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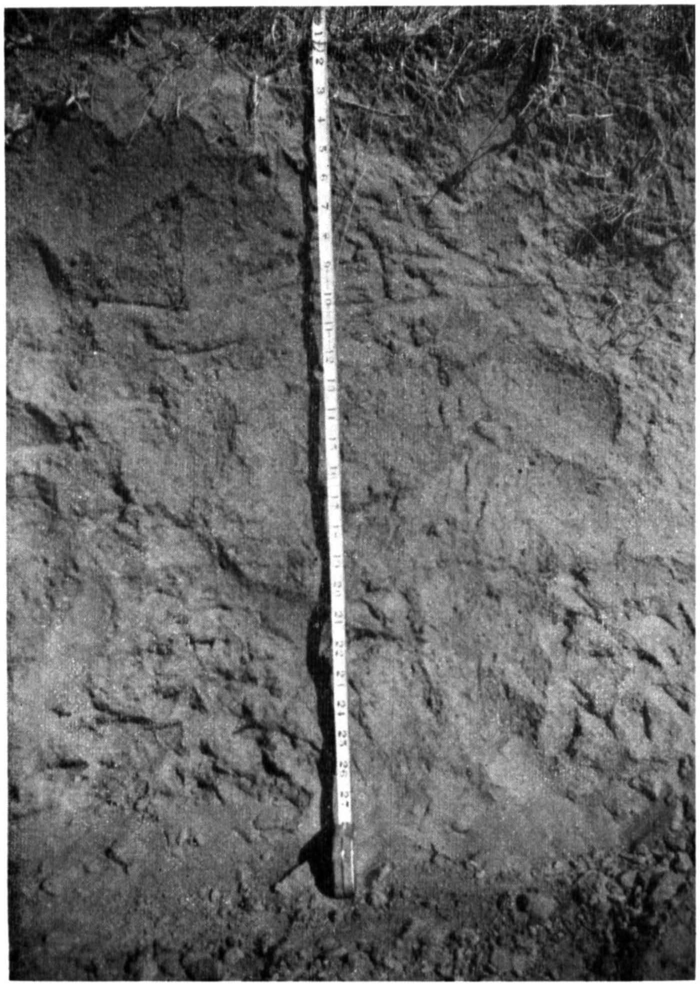

Figure 30.—**Profile of Valentine fine sand.**

organic-matter content is generally low. In some places a slightly darkened transitional horizon, as much as 8 inches thick, is between the surface layer and the parent material of light-colored sand.

The Valentine soils are excessively drained. Permeability is rapid. Natural fertility and the available water capacity are low. These porous soils absorb all precipitation and have no runoff, but they are very susceptible to wind erosion if unprotected by plants.

These soils are suitable only for grass, and nearly all the acreage is native grassland. On the moderately sandy uplands, however, a few small areas adjacent to Anselmo soils are cultivated.

Valentine fine sand, rolling (VaC).—Most of this soil occurs in a single large area southeast of Chappell where it makes up most of the sandhills (fig. 31). Here all of the soil is in native grass, and nearly all is only slightly eroded, though a few severely eroded spots are included. Small areas of this soil also occur with Anselmo soils on the moderately sandy uplands; most of these areas are cultivated and eroded. (Capability unit VIe–5, dryland; Sands range site; Very Sandy woodland site)

Valentine fine sand, hilly (VaD).—This soil occurs in only a small area southeast of Chappell, near the Colorado line. It occupies hummocky slopes of more than 15 percent and is sometimes called choppy sands, for the steepest parts have sloughed in some places and have formed a series of steps called catsteps. Because the surface is now stabilized under a cover of native plants, erosion is generally slight, but there are included spots that are severely eroded by wind. (Capability unit VIIe–5, dryland; Choppy Sands range site; Very Sandy woodland site)

Wann Series

Soils of the Wann series are deep, dark, calcareous, and imperfectly drained. They are immature soils that formed on bottom lands along the South Platte River in moderately sandy alluvium underlain by gravel. Their surface is nearly level and commonly is channeled. (See fig. 8, p. 6.)

These soils have a dark surface layer that is about 17 inches thick and contains much lime carbonate. The top 8 inches of this layer is very dark gray, granular, and friable, but the lower part is very dark brown and has coarse, blocky structure.

Stratified layers of calcareous alluvium make up the parent material. These layers consist mainly of structureless sand and fine sandy loam, but a few, thin layers of fine-textured material occur in many places. Because the water table fluctuates, stains and mottles are common. Above the water table, roots easily penetrate this horizon.

The underlying material is a mixture of loose sand and gravel that blocks the penetration of roots.

The Wann soils have a sandier subsoil than the Las soils. They are deeper over gravel beds than the Las Animas soils and have a more coherent subsoil.

The surface layer ranges from about 6 to 18 inches in thickness, from nearly black to very dark grayish brown in color, and from silt loam to very fine sandy loam in texture. In some places there is a subsoil of very fine sandy loam to sandy loam, 4 to 10 inches thick, that is transitional between the surface horizon and the parent material. The parent material occurs at a depth of about 18 inches. It consists mostly of fine sandy loam to sand and is considerably stratified. A few, thin, fine-textured strata occur in some places. The gravelly underlying material

Figure 31.—**Landscape of Valentine soils.**

is 30 to 40 inches below the surface. The water table fluctuates between the depths of 20 and 40 inches.

In these imperfectly drained soils, permeability is moderate. Surface runoff is slow. Natural fertility is medium. The soils are easily worked but are likely to blow if they are not protected.

The Wann soils are suited to native grass and to all cultivated crops grown in the county. Most of the acreage is used for irrigated crops, mainly corn and sugar beets, and the rest is in native grass.

Wann loam (Wm).—This nearly level, slightly eroded soil is the only Wann soil in Deuel County. It is inextensive and occurs in only a few, long areas that parallel the South Platte River. These areas are 15 to 160 acres in size. They are dissected by a few narrow channels that contain Las Animas soils, which are included. The channels are filled in fields that have been leveled for irrigation. (Capability unit IIw-4, dryland; IIw-4, irrigated; Subirrigated range site; Moderately Wet woodland site)

Wet Alluvial Land (Wx)

Wet alluvial land is a miscellaneous land type that consists mainly of loose, stratified, light-colored sand and gravel. It occurs within and adjacent to the old channels of the South Platte River where sediments were recently deposited. (See fig. 8, p. 6.) It is generally very shallow and contains a large amount of gravel. In many places loamy material is in thin strata either on the surface or below the surface between strata of sand and gravel. The areas generally have a water table within 1 to 2 feet of the surface and are flooded when the river is high. A good stand of grass covers areas that have loamy strata and are affected by a high water table. Gravelly spots lack a high water table and are nearly bare of grass. Figure 32 shows an area of Wet alluvial land.

This land type is used for pasture. Mid and tall grasses dominate grassy areas, and annual weeds cover much of the land where grass is lacking. Most areas have a growth of cottonwoods and willows that forms a 30 percent canopy, or covering of leaves and branches. (Capability unit VIIs-3, dryland; Very Shallow Porous range site; no woodland site)

Figure 32.—**Landscape of Wet alluvial land.**

Formation and Classification of the Soils

This section consists of three main parts. The first part explains how the factors of soil formation affect the development of soils in Deuel County. In the second part, after the soil series of the county have been placed into higher categories, each soil series and a soil typical of the series are described. In the third part, data from mechanical and chemical analysis of selected soils are given in a table and the profiles of these selected soils are described.

Factors of Soil Formation

The soils in Deuel County and elsewhere have formed as a result of complex physical, chemical, and biological processes. The degree and nature of soil development at a given location depends on the influence that each of the following factors have exerted: (1) kind of parent material, (2) climate, (3) plant and animal life, (4) relief and drainage, and (5) time. These five factors are important in the formation of every soil in this county, and elsewhere, but at a given place some factors have more influence than others.

Parent material

The five kinds of parent material from which the soils in Deuel County formed are loess, alluvium, eolian sand, Tertiary sandstone, and Pleistocene gravel. The kinds of soils that formed on the different parent and geological materials are shown in figures 2, 4, 6, 8, 9, and 33. Most soils on uplands developed in silt deposited by wind, and some developed in eolian sand, residual sandstone, and Pleistocene gravel. The soils on benches developed in old sandy and silty alluvium that, in some places, has been recently shifted by wind. Some soils on benches have been considerably influenced by gravelly alluvium. The soils on bottom lands have no significant development. They consist of clayey, silty, sandy, and gravelly deposits that were recently laid down by water.

The parent material of the silty soils on uplands consists mainly of a thin mantle of Peorian loess. The presence of buried soils indicates that this material was deposited during at least two different periods.

The sandy soils of uplands developed in eolian sands. The sand in the largest area of these sandy soils was blown from the valley of Lodgepole Creek and deposited in a narrow band along the eastern side. Small areas of sand occur in the northeastern part of the county where the wind blew away fine soil particles and left the coarse ones.

The residual soils have developed on uplands in highly calcareous, silty and sandy material that was washed from the Rocky Mountains and deposited during Tertiary time. The Ogalalla formation is the main deposit on the Deuel County plain. This material is mostly sandy and, in some places, has been cemented with lime to form mortar beds. Soils formed in these calcareous, residual parent materials are generally on protruding knolls or knobs. In the surface layer of these soils are admixtures of recently deposited Peorian loess.

The gravelly parent materials on the uplands give rise to very shallow, shallow, and moderately deep soils. On slopes along the streams is unconsolidated coarse gravel

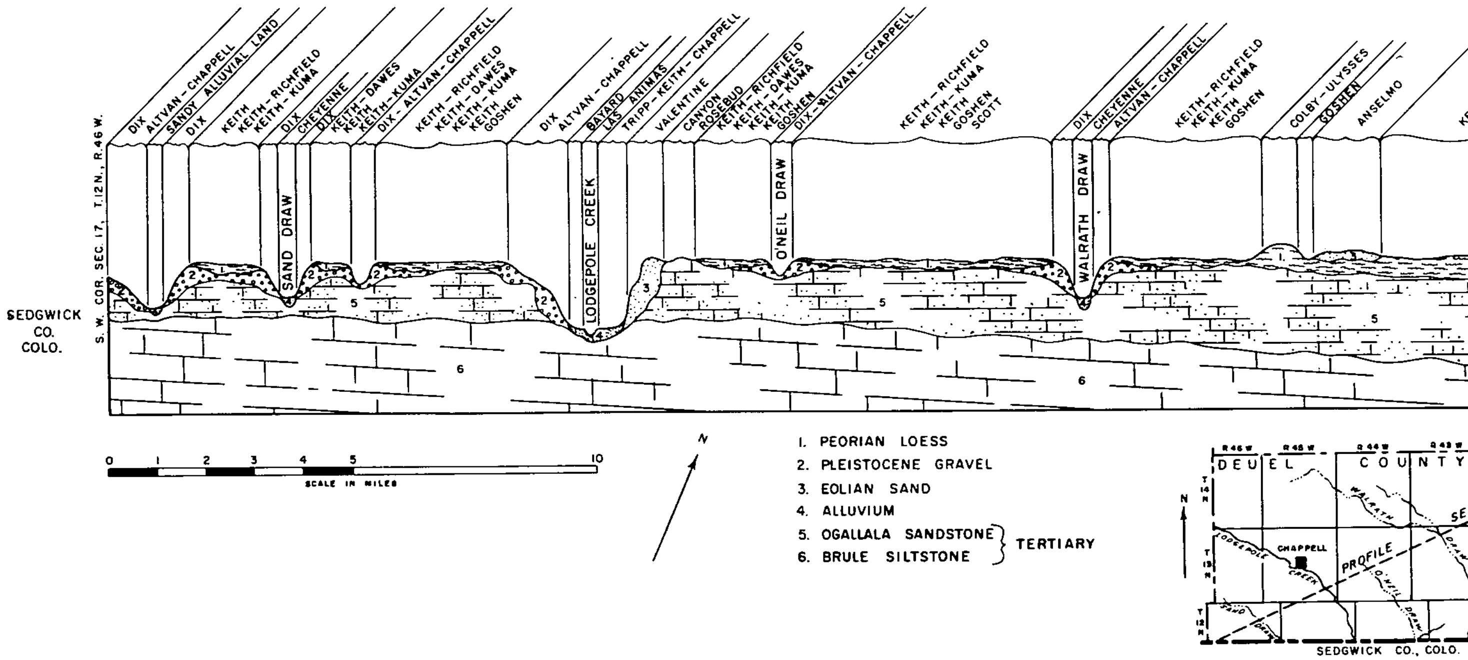

Figure 33.—**Generalized southwest-northeast geological profile section across Deuel County, Nebraska, with associat**

that was deposited by water, probably in early to mid Pleistocene time. Since the gravel was deposited, the streams have been more deeply entrenched.

In places these gravelly deposits have been recently covered by thin layers of Peorian loess.

Climate

Deuel County has a temperate, semiarid climate that is typical of the High Plains. Days are hot in summer but the nights are cool. Winters are cold, but occasional warm spells cause the soils to freeze and thaw. The growing season is rather short and averages about 133 days. The mean annual temperature is about 48° F.

Rainfall is low and varies from year to year in amount and distribution. Storms, which occur mainly in the spring, are generally intense; water erosion is common on slopes. The mean annual rainfall is about 17 inches. Because leaching is incomplete, calcium carbonate accumulates in the lower subsoils of the well-developed soils. Some clays have also accumulated in the subsoils through leaching. The dark Chestnut soils with granular surface soil and prismatic, calcareous subsoil are the well-developed zonal soils of the county. These soils primarily reflect the influence of the climate and of the native grass vegetation.

Winds have influenced the formation of most soils in the county. The long narrow incomplete ridges are the result of strong winds that blew from the northwest. The parent materials of loess and eolian sands were transported mainly by wind. In recent years all soils have gained or lost small amounts of windblown materials.

By exerting a strong influence on the kinds of plants that grow on the zonal soils, the climate has exerted a powerful indirect influence on the formation of soils.

Plant and animal life

Various forms of plants and animals live on and in the soil and are active in the soil-forming processes. The changes brought about by these biological forces depend on the kinds of life and life processes peculiar to each plant or animal. The kinds of plants and animals that live on and in the soil are determined by climate, parent material, relief and drainage, age of the soil, and by associated plants and animals. Vegetation, to a great extent, is controlled by the climate.

The well-developed Chestnut soils of Deuel County are largely the result of the effects of climate and of plants and animals on the parent material. These soils are zonal, and they are dark-colored soils typical of grasslands. They have developed under short and mid grasses, which have supplied abundant organic matter. The organic matter has been transformed into humus by micro-organisms, earthworms, and other animal life, and by direct chemical reactions. Small burrowing animals and earthworms influence soil formation by mixing the organic and mineral matter of the soil and by deepening the zone in which organic matter accumulates. They also keep the soil supplied with minerals by bringing unleached material to the surface.

Relief and drainage

The soils of Deuel County range from nearly level to steep. The slope gradient and the type of slope partly determine how much runoff will occur, how much water infiltrates the soil, and how much soil is likely to be lost through erosion.

In Deuel County, the zonal soils that are nearly level or very gently undulating are the thickest and most strongly developed. They absorb more water than do sloping soils. Consequently, more vegetation is produced and that, in turn, produces more organic matter. Because of the additional moisture, leaching of soluble minerals and clay particles is deeper than in the more sloping soils. Thus, the thickest soils are formed on the gentlest slopes.

The degree of soil development that takes place, within a given time on a particular kind of parent material and under a cover of similar plants, depends mostly on the amount of water entering and passing through the soil. Generally, profile development is thinner on the steeper slopes because runoff and erosion are greater. The lime zones in steep soils are at or near the surface because there has been little leaching and slow soil development.

Soils that have formed on similar parent material under similar vegetation but that differ in relief and drainage may be grouped in sequences called catenas. In Deuel County the Scott, Richfield, Keith, Ulysses, and Colby soils form a catena. In this catena the soils are arranged progressively from the low-lying Scott to the strongly sloping Colby. The Scott soils receive and retain the greatest amount of moisture and the Colby the least.

By affecting drainage, relief is important in soil development. Poorly drained depressions have a claypan because much colloidal clay has been leached into the subsoil.

Organic materials decay slowly in wet areas that have a high water table. Saline or alkali soils develop in places where the underlying water contains an excess of salts. Through the process of upward leaching and evaporation, the excessive amounts of soluble salts are deposited in the soil profile.

Time

The development of soils from the various kinds of parent material requires considerable time that varies according to the kinds of parent material. Surface soils become darkened when organic matter, mainly that from decayed plants, is added to the soil. During periods of rainfall, calcium carbonate and other soluble minerals are leached from the surface horizons. Clay is also leached from the A horizon and is deposited in the B horizon, but this process is slow and depends on how fast materials weather in the upper horizons. Soils with well-defined and genetically related horizons have developed on parent materials that have been in place for a long time. Most of the alluvial soils on bottom land consist of materials that have been in place for only a short time.

More time is required for normal soils to develop in the resistant, coarse, rocky parent material than is required in parent materials that are finely divided and nonresistant. The Valentine, Dix, and Canyon soils are immaturely developed and are young. All these soils developed from resistant parent materials. The parent materials of Valentine soils are coarse and sandy; those of the Dix soils are gravelly; and those of the Canyon soils are rocky. The parent materials of the mature Keith soils are nonresistant and silty. The Colby and other soils on steep slopes have had their materials constantly removed by

geologic erosion and, therefore, lack distinct, genetically related horizons.

Some soils in Deuel County have been in place long enough to reach equilibrium with their environment. These soils are mature. The most mature soils in the county are on nearly level, silty uplands and benches. They have distinct, genetically related horizons.

Classification of Soils

Soils are grouped in narrow classes so that knowledge about their behavior can be organized and applied within farms and ranches and within a small area such as a county. They are also grouped in broad classes for study and comparison in the United States and in other large areas. Following the comprehensive system of soil classification used in the United States (*3*), the soils of Deuel County are grouped into four major categories. Beginning at the highest and broadest these categories are order, great soil group, series, and type. In table 10 the soil series in the county are classified in higher categories. Suborder and family categories have also been recognized, but they have not been fully developed and thus are not used in classifying the soils of Deuel County.

The soil type, which is the lowest category, is a subdivision of a soil series based on the texture of the surface soil. Keith silt loam and Keith fine sandy loam are two soil types within the Keith series.

The soil phase, which is not itself a category in the soil classification system, is a subdivision of any class but is most commonly used as a segment of the soil type. Keith silt loam, 3 to 5 percent slopes, and Keith silt loam, 3 to 5 percent slopes, eroded, are slope and eroded phases of the Keith silt loam soil type. Many of the mapping units shown on the detailed soil map are soil types or soil phases.

Soil orders

Classes in the highest category of the classification system are the zonal, intrazonal, and azonal orders (*17*).

Soils in the zonal order have distinct, genetically related horizons that reflect the predominant influence of the active factors of soil formation, climate and living organisms, mainly vegetation.

Soils within the intrazonal order have more or less well developed soil characteristics that reflect the dominant influence of the local factors of relief or parent material over the normal effects of climate and vegetation.

The azonal order consists of soils that lack distinct, genetically related horizons because of youth, resistant parent material, or steep topography.

Great soil groups

The soils of Deuel County are classified into seven great soil groups (*1*). This category is the most useful and widely used grouping of the higher categories. The seven great soil groups in the county are described in the following paragraphs.

The *Alluvial soils* of Deuel County occur principally in the valleys of the South Platte River and Lodgepole Creek. They also occur in uplands along small intermittent drainageways. They are azonal soils on stream-laid sediments of first bottoms and low terraces. They make up about 5 percent of the acreage in Deuel County.

Alluvial soils have little, if any, profile development, for the soil-forming processes have had little direct effect. The properties of these soils are similar to those of their parent materials. Alluvial soils range widely in reaction, texture, and natural drainage.

Chestnut soils amount to about 83 percent of the total land area of Deuel County. They are zonal soils that developed in a temperate, semiarid climate under mixed mid and short grasses.

The A horizon is dark colored, and the plow layer is about 2 to 4 percent organic matter. The A horizon is normally granular in structure and about neutral in reaction. The B horizon is dark colored, and its macrostructure is weak to moderate and prismatic. Microstructure is weak to moderate and subangular blocky. The lower B horizon normally contains free lime carbonate. The C horizon consists of parent material that is calcareous and only slightly altered.

Lithosols in Deuel County are rocky and gravelly, and they range from about 0 to 20 inches in thickness. These azonal soils are principally rolling to steep. They amount to about 7 percent of the acreage in the county. Vegetation is sparse and consists mainly of short grasses.

Lithosols have an AC profile, though some have a very weakly developed B horizon. The A horizon is usually thinner and lighter colored than is that in adjacent Chestnut soils. The C horizon in the Lithosols of Deuel County contains little unconsolidated material.

The *Planosols* in Deuel County are on upland flats and make up 2 percent of the total land area. These soils formed under grass, mainly from medium-textured loess. Through eluviation and illuviation, clay has moved out of the A horizon, and has accumulated in the subsoil, where it has formed a compact, fine-textured claypan.

The Planosols have a moderately dark A1 horizon, 4 to 10 inches thick. They normally have a thin, gray, leached A2 horizon that is directly underlain by the claypan of the B horizon. In some places the A2 horizon is absent or faint in Deuel County. The claypan of the B2 horizon is thick and quite compact. It has prismatic structure and is plastic when moist and hard when dry.

The *Regosols* of Deuel County cover about 2 percent of the land area. These soils are on eolian sands and silts. They have weakly developed profiles. The typical profile includes an A, an AC, and a C horizon. In a few places a very weak B horizon occurs. Regosols developed in this county where materials are coarse, the topography is steep, and time was too short for distinct profiles to develop.

The A horizon is thin and about the same color as that in associated Chestnut soils. The AC horizon consists of slightly altered material that is transitional between that in the A and C horizons in texture, color, and structure. Unweathered or only slightly weathered sands and silts make up the C horizon.

The *Solodized-Solonetz soils* make up slightly less than 1 percent of the land area. These intrazonal soils are loamy and occur on nearly level uplands that have restricted drainage. The soils are high in exchangeable sodium. They have a well-defined, columnar B2 horizon that contains considerably more clay than the A horizon. Most profiles show some evidence of degradation. The Solodized-Solonetz soils of Deuel County are not nor-

TABLE 10.—*Classification and principal characteristics of soil series*

Soil series	Great soil group	Soil order	Dominant texture in subsoil	Parent material	Relief and position	Natural drainage class
Altvan	Chestnut	Zonal	Sandy clay loam or clay loam.	Mixed eolian silt and gravel.	Undulating to rolling upland.	Well drained.
Anselmo	Chestnut	Zonal	Fine sandy loam	Eolian sand and silt.	Nearly level to rolling upland.	Somewhat excessively drained.
Bayard	Chestnut (intergrading toward Regosol).	Zonal	Fine sandy loam	Old sandy alluvium.	Nearly level benchland.	Somewhat excessively drained.
Bridgeport	Chestnut (intergrading toward Regosol).	Zonal	Very fine sandy loam.	Silty calcareous colluvium and alluvium.	Nearly level to very gently sloping benchland.	Well drained.
Canyon	Lithosol	Azonal	Limy, partly weathered sandstone.	Mixed eolian silt and calcareous Tertiary sandstone.	Undulating to steep upland.	Somewhat excessively to excessively drained.
Chappell	Chestnut	Zonal	Sandy loam or loam.	Mixed eolian silt, sand, and gravel.	Nearly level to rolling upland and benchland.	Well drained to somewhat excessively drained.
Cheyenne	Chestnut	Zonal	Loam	Old alluvial silt mixed with sand and gravel.	Nearly level to very gently sloping benchland.	Well drained.
Colby	Regosol	Azonal	Silt loam	Calcareous Peorian loess.	Undulating to hilly upland.	Well drained to excessively drained.
Dawes	Solodized-Solonetz	Intrazonal	Silty clay	Peorian loess	Nearly level to very gently sloping upland.	Moderately well drained.
Dix	Chestnut (intergrading toward Regosol).	Zonal	Gravelly loam or gravel.	Mixed eolian silt and gravel.	Rolling to steep upland.	Excessively drained.
Dunday	Regosol	Azonal	Fine sand	Eolian sand	Nearly level to very gently sloping upland.	Excessively drained.
Goshen	Chestnut	Zonal	Silty clay loam	Peorian loess and silty colluvium.	Swales in nearly level to very gently sloping upland.	Well drained.
Havre	Alluvial	Azonal	Very fine sandy loam.	Recent silty alluvium.	Nearly level to very gently sloping bottom land.	Well drained
Keith	Chestnut	Zonal	Silt loam or light silty clay loam.	Peorian loess	Nearly level to rolling upland.	Well drained.
Kuma	Chestnut	Zonal	Silty clay loam	Peorian loess	Nearly level upland	Well drained.
Las	Alluvial	Azonal	Silty clay loam or clay loam.	Recent silty alluvium.	Nearly level bottom land.	Imperfectly drained.
Las Animas	Alluvial	Azonal	Gravelly loamy sand.	Recent sandy alluvium over gravel.	Nearly level to very gently sloping bottom land.	Imperfectly drained.
Laurel	Solonchak	Intrazonal	Clay loam or sandy clay loam.	Recent silty alluvium.	Nearly level bottom land.	Poorly drained.
Nunn	Chestnut	Zonal	Silty clay loam	Old silty alluvium.	Near level benchland	Moderately well drained.
Richfield	Chestnut	Zonal	Silty clay loam	Peorian loess	Nearly level to very gently sloping upland.	Well drained.
Rosebud	Chestnut	Zonal	Loam or clay loam	Eolian silt mixed with calcareous Tertiary sandstone.	Nearly level to hilly upland.	Well drained.
Scott	Planosol	Intrazonal	Silty clay	Peorian loess	Nearly level upland depressions.	Poorly drained.
Tripp	Chestnut	Zonal	Silt loam or light silty clay loam.	Old silty alluvium.	Nearly level to very gently sloping benchland.	Well drained.
Ulysses	Chestnut (intergrading toward Regosol).	Zonal	Silt loam	Calcareous Peorian loess.	Undulating to hilly upland.	Well drained to excessively drained.
Valentine	Regosol	Azonal	Fine sand	Eolian sand	Undulating to steep, hummocky upland.	Excessively drained.
Wann	Alluvial	Azonal	Fine sandy loam	Recent sandy alluvium over gravel.	Nearly level bottom land.	Imperfectly drained.

mally continuous in large areas but occur mostly in local spots.

Only about 200 acres of *Solonchak soils* occur in Deuel County. These soils are loamy and poorly drained, and they have a high concentration of soluble salts. They occur on the nearly level bottom lands of Lodgepole Creek and the South Platte River. This group of soils lack clearly differentiated horizons. In this county they occur in local areas and are not continuous.

Soil series

This subsection was prepared for those who need more detailed information about the soils in the county than is given elsewhere in the report. In the following pages, each soil series is described generally and a profile of a soil typical of the series is described in detail.

For some horizons the pH values and soluble salt percentages are given. The pH values and soluble salt percentages were determined in a suspension of two parts water and one part soil. The glass electrode was used to determine pH values, and the dip-type electrode was used to determine soluble salt percentages.

ALTVAN SERIES

In the Altvan series are moderately well developed, sloping Chestnut soils of the uplands. These soils developed in 20 to 38 inches of mixed silty and sandy material that was deposited partly by water and partly by wind. Underlying materials consist of calcareous, mixed sand and gravel. Altvan soils are deeper and less gravelly than Dix soils and are more silty than the Chappell soils. They are less silty than the Keith soils. Altvan soils are more clayey in their subsoils than Rosebud soils and are over beds of Pleistocene sands and gravels instead of calcareous Tertiary sandstone.

Profile of Altvan loam (about 0.2 mile north and 200 feet west of the southeast corner of sec. 9, T. 13 N., R. 45 W.; native grassland):

A1—0 to 7 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

B21t—7 to 15 inches, dark grayish-brown or grayish-brown (10YR 4.5/2) sandy clay loam, very dark grayish brown (10YR 3.5/2) when moist; moderate, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B22t—15 to 20 inches, light brownish-gray (10YR 6/2) sandy clay loam, dark grayish brown (10YR 4/2) when moist; moderate, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B3—20 to 27 inches, pale-brown (10YR 6/3) sandy clay loam, dark grayish brown or dark brown (10YR 4/2.5) when moist; thin lenses of gravel; moderate, coarse, prismatic structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

Cca—27 to 34 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) when moist; thin lenses of gravel; structureless; slightly hard when dry, friable when moist; highly calcareous; much soft, white lime; clear, wavy boundary.

IIC—34 to 60 inches, highly calcareous mixed sand and fine gravel; structureless; loose when dry or moist but fine particles in upper part gives horizon slight coherence when wet.

The A horizon ranges from 5 to 10 inches in thickness. The subsoil averages about 18 inches in thickness, but the range is 10 to 20 inches. The subsoil ranges from heavy loam to clay loam but is generally sandy clay loam or clay loam. The lower subsoil is noncalcareous or calcareous. In many places, especially in the shallow soils, the Cca horizon does not occur. Throughout the profile gravel ranges from a trace to much, but the gravel content is not great enough in any place for Altvan soils to be classified gravelly.

ANSELMO SERIES

The Anselmo series consists of Chestnut soils that are deep, are immature, and developed in a mixture of eolian sand and silt. They occur on uplands on the single and complex slopes of nearly level to rolling topography. Anselmo soils are scattered in small areas between the sandier Valentine soils and the siltier Keith soils. The Anselmo soils are darker and more developed than the Valentine soils. They have a sandier subsoil, are lighter colored, and are less well developed than the silty Keith soils.

Profile of Anselmo fine sandy loam (about 0.2 mile north and 500 feet west of the southeast corner of sec. 32, T. 14 N., R. 42 W.; fallow cropland):

A1p—0 to 7 inches, grayish-brown (10YR 5/2) light fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A12—7 to 10 inches, dark grayish-brown (10YR 4/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B1—10 to 27 inches, brown (10YR 5/3) light fine sandy loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B2—27 to 44 inches, grayish-brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure; slightly hard when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

C1—44 to 50 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; structureless; slightly hard when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

C2—50 to 60 inches, very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) when moist; structureless; slightly hard when dry, very friable when moist; noncalcareous.

When moist, the A horizon ranges from very dark grayish brown to dark grayish brown. It is 6 to 16 inches thick. The surface soil is fine sandy loam, sandy loam, loamy fine sand, or loamy sand. The subsoil ranges from 12 to 30 inches in thickness and, in some places, is a transitional zone between the A and C horizons. It is light fine sandy loam or heavy fine sandy loam. The parent materials are mixtures of sand and silt and range from light loam to loamy sand. These materials are sometimes calcareous in the lower C horizon.

BAYARD SERIES

The Bayard series consists of Chestnut soils that intergrade toward Regosols. These deep, immature soils developed in a mixture of calcareous alluvial sand and silt. They occur on high bottoms and stream terraces on nearly level slopes along Lodgepole Creek and the South Platte

River. Bayard soils are sandier in their upper horizons than the Cheyenne soils and are deeper and less gravelly. They are deeper, have more uniform texture, and are less gravelly than Chappell soils of the high terraces. Bayard soils occupy positions similar to those of Tripp soils but are sandier and less well developed.

Profile of Bayard fine sandy loam (about 0.15 mile north and 50 feet east of the southwest corner of sec. 23, T. 13 N., R. 45 W.; irrigated field):

- A1p—0 to 10 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; slightly calcareous; abrupt, smooth boundary.
- A12—10 to 19 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, blocky structure; soft when dry, very friable when moist; slightly calcareous; clear, smooth boundary.
- AC—19 to 23 inches, light brownish-gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, blocky structure; soft when dry, very friable when moist; highly calcareous; clear, smooth boundary.
- C1—23 to 36 inches, light-gray (10YR 7/2) light fine sandy loam, grayish brown (10YR 5/2) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.
- C2—36 to 46 inches, light-gray (10YR 7/2) fine sandy loam light brownish gray (10YR 6/2) when moist; structureless; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.
- C3—46 to 54 inches, light-gray (10YR 7/2) loamy fine sand, light brownish gray (10YR 6/2) when moist; structureless; soft when dry, very friable when moist; highly calcareous; abrupt, smooth boundary.
- A1b1—54 to 56 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) when moist; structureless; soft when dry, very friable when moist; highly calcareous; abrupt, smooth boundary.
- A1b2—56 to 62 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; structureless; soft when dry, very friable when moist; highly calcareous.

The A horizon of the Bayard soils ranges from about 10 to 20 inches in thickness. It is noncalcareous in some places. In some places the AC horizon is as much as 9 inches thick, but in other places it is missing. In many places the parent material consists of stratified layers of loamy sand and very fine sandy loam. Silt loam strata occur deep in the C horizon in many places. Bayard soils contain small amounts of gravel in a few places.

BRIDGEPORT SERIES

The Bridgeport series consists of Chestnut soils that intergrade toward Regosols. These deep, immature soils developed in light-colored, colluvial-alluvial materials that consist of highly calcareous, mixed silt and sand. They occur with the Tripp soils on the nearly level to very gently sloping stream terraces, but are lighter colored, slightly sandier, more limy, and less well developed.

Profile of Bridgeport loam (about 0.25 mile east and 250 feet north of the southwest corner of the NW¼ of sec. 18, T. 12 N., R. 44 W.; irrigated field of beans):

- Alp—0 to 8 inches, light brownish-gray (10YR 6/2) loam, very dark grayish brown or dark grayish brown (10YR 3.5/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; highly calcareous; abrupt, smooth boundary.

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- AC—8 to 14 inches, light brownish-gray (10 YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, blocky structure; soft when dry, very friable when moist; highly calcareous; clear, smooth boundary.
- C1—14 to 19 inches, light-gray (10YR 7/2) very fine sandy loam, grayish brown (10YR 5/2) when moist; weak, coarse, blocky structure; soft when dry, very friable when moist; highly calcareous; clear, smooth boundary.
- C2—19 to 22 inches, light-gray (10YR 7/2) silt loam, dark grayish brown or grayish brown (10YR 4.5/2) when moist; weak, coarse, blocky structure; slightly hard when dry, very friable when moist; highly calcareous; clear, smooth boundary.
- C3—22 to 35 inches, light-gray (10YR 7/2) light very fine sandy loam, grayish brown (10YR 5/2) when moist; structureless; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.
- C4—35 to 60 inches, light brownish-gray (10YR 6/2) light fine sandy loam, grayish brown (10YR 5/2) when moist; structureless; soft when dry, very friable when moist; highly calcareous; 1½-inch layer of dark-brown (10YR 3/3, moist) silt loam in upper part.

When moist, the A horizon ranges from very dark grayish brown to dark grayish brown. It is very fine sandy loam to silt loam. The AC horizon ranges from 6 to 20 inches in thickness and from silt loam to very fine sandy loam in texture. The C horizon is stratified with light-colored sand and silt but consists mainly of very fine sandy loam to silt loam. Fine sandy loam and loamy sand are common deep in the profile.

CANYON SERIES

In the Canyon series are Lithosols that developed on highly calcareous residuum of Tertiary sandstone. These soils are 10 to 20 inches deep. They occur chiefly in undulating to steep uplands on knolls surrounded by other soils. Canyon soils occur with Rosebud soils but are shallower and not so well developed.

Profile of Canyon loam (about 50 feet west and 40 feet south of the northeast corner of sec. 33, T. 13 N., R. 46 W.; native grassland):

- A1—0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; many hard fragments of sandstone; weak, fine, granular structure; soft when dry, very friable when moist; highly calcareous; abrupt, smooth boundary.
- C—6 to 11 inches, partly weathered sandstone of loamy texture; contains hard fragments of sandstone; nearly white but slightly darkened by organic matter; highly calcareous; abrupt, wavy boundary.
- R—11 to 24 inches, weakly consolidated white Tertiary sandstone; highly calcareous.

The depth to the weakly consolidated Tertiary sandstone is the principal variation of the Canyon soils in Deuel County. In most places this depth ranges from 10 to 20 inches, but unweathered bedrock crops out in many small areas. Rock fragments range from few to many on the surface and in the upper part of the profile.

CHAPPELL SERIES

The Chappell series consists of weakly to moderately developed Chestnut soils. These soils of the uplands and high terraces developed on slopes in 20 to 36 inches of mixed silty and sandy material that was deposited partly by water and partly by wind. Mixed, calcareous sand and gravel is the underlying material. Chappell soils are deeper over sand and gravel than the Dix soils. Except that they are coarser textured, Chappell soils are similar

to Altvan soils in profile characteristics. Chappell soils resemble the Rosebud fine sandy loams but developed from mixed sand and silt over gravel rather than from calcareous Tertiary sandstone.

Profile of Chappell sandy loam (about 0.3 mile north and 0.25 mile east of the southwest corner of sec. 28, T. 14 N., R. 46 W.; native grassland):

A1—0 to 7 inches, grayish-brown (10YR 5/2) heavy sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

B2—7 to 17 inches, grayish-brown (10YR 5/2) heavy sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

C1—17 to 25 inches, light brownish-gray (10YR 6/2) coarse sandy loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

Cca—25 to 35 inches, white (10YR 8/2) gravelly loamy sand, brown (10YR 5/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous; weak clods formed by cementation; gradual, smooth boundary.

IIC—35 to 60 inches, loose, highly calcareous sand and gravel.

Both the A horizon and the subsoil range from sandy loam to light loam. The A horizon ranges from about 6 to 15 inches in thickness, and the subsoil ranges from 10 to 20 inches. The amount of gravel in the solum ranges from little to much, but no horizon contains enough gravel for it to be classified gravelly.

CHEYENNE SERIES

The Cheyenne series consists of weakly developed Chestnut soils that formed on gravelly, colluvial-alluvial deposits on fans and high terraces. The development of these soils has been considerably influenced by recent colluvial-alluvial deposits consisting of mixed silty and sandy material of local origin. The parent materials of normally noncalcareous, stratified sand and gravel occur at a depth of 20 to 36 inches. Cheyenne soils occur in positions similar to those of Chappell soils but are not so sandy and gravelly. They are more gravelly and shallow than Tripp soils and do not contain so much silt. Cheyenne soils are younger and less well developed than the more sloping Altvan soils.

Profile of Cheyenne loam (about 0.3 mile north and 200 feet west of the southeast corner of sec. 11, T. 13 N., R. 46 W.; fallow cropland):

A1p—0 to 6 inches, grayish-brown (10YR 5/2) light loam, very dark grayish brown (10YR 3/2) when moist; many scattered small pebbles; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A12—6 to 16 inches, dark-gray or gray (10YR 4.5/1) loam, very dark brown (10YR 2/2) when moist; many scattered small pebbles; weak, coarse, blocky structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

AC—16 to 22 inches, grayish-brown (10YR 5/2) light loam, very dark grayish brown or dark grayish brown (10YR 3.5/2) when moist; many scattered fine pebbles; weak, coarse, blocky structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

C1—22 to 32 inches, light brownish-gray (10YR 6/2) gravelly sandy loam, dark grayish brown (10YR 4/2) when moist; high content of gravel; structureless; loose when dry, loose when moist; noncalcareous; clear, smooth boundary.

C2—32 to 44 inches, grayish-brown (10YR 5/2) sandy loam, dark grayish brown (10YR 4/2) when moist; structureless; soft when dry, very friable when moist; noncalcareous.

The AC horizon ranges from 6 to 16 inches in thickness. The solum ranges from loam to light loam. The depth to the underlying sand and gravel ranges from 20 to 36 inches or slightly more. The profile is generally noncalcareous, but there is calcareous sand and gravel in a few places.

COLBY SERIES

The Colby soils are calcareous Regosols that developed in thick deposits of Peorian loess. These azonal soils occur mainly on convex slopes and ridges in hilly topography. The Colby soils have a thinner A1 horizon and a less dark solum than the Ulysses and Keith soils and are more calcareous and more weakly developed. Colby soils are steeper than the Ulysses and Keith soils but formed from the same kinds of parent material.

Profile of Colby silt loam (about 0.1 mile north and 100 feet west of the southeast corner of the NW¼ of sec. 6, T. 14 N., R. 41 W.; eroded soil allowed to return to grass):

A1—0 to 6 inches, grayish-brown or light brownish-gray (10YR 5.5/2) silt loam, very dark grayish brown or dark grayish brown (10YR 3.5/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; highly calcareous; clear, smooth boundary.

AC—6 to 9 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; highly calcareous; clear, smooth boundary.

C—9 to 60 inches, light-gray or very pale brown (10YR 7/2.5) silt loam, brown or pale brown (10YR 5.5/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous.

The A horizon ranges from 3 to 7 inches in thickness. It ranges from very dark grayish brown to dark grayish brown when moist. The thin AC horizon is missing in some places. The C horizon ranges from silt loam to very fine sandy loam.

DAWES SERIES

The intrazonal Dawes soils are deep, dark Solodized-Solonetz soils that have a claypan. They developed mainly in calcareous Peorian loess on nearly level slopes that have no drainageways. The Dawes soils have more clay in their subsoil, are more strongly developed, and are less well drained than the Richfield, Keith, Kuma, or Rosebud soils. Dawes soils are deep over calcareous Pleistocene gravel, but the Rosebud soils are moderately deep over calcareous Tertiary sandstone. Dawes soils have better drainage and have less clay in their subsoil than the Scott soils.

Profile of Dawes loam (about 0.2 mile south and 250 feet east of the northwest corner of the NE¼ of sec. 22, T. 12 N., R. 46 W.; field in rye stubble):

A1p—0 to 5 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; few scattered pebbles; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A2—5 to 7 inches, gray (10YR 6/1) silt loam, dark gray or dark grayish brown (10YR 4/1.5) when moist; few scattered pebbles; weak, coarse, blocky structure; soft

when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

B21t—7 to 13 inches, dark-gray or gray (10YR 4.5/1) silty clay, very dark brown (10YR 2/2) when moist; few scattered pebbles; strong, medium, columnar structure breaking to strong, fine, angular blocky structure; distinctly rounded caps on columns; hard when dry, firm when moist; noncalcareous; clear, smooth boundary.

B22t—13 to 18 inches, pale-brown (10YR 6/3) silty clay loam, dark brown (10YR 4/3) when moist; few scattered pebbles; moderate, medium, prismatic structure breaking to moderate, fine and medium, angular blocky structure; hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

C1—18 to 21 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; few scattered pebbles; weak, coarse, prismatic structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

Cca—21 to 36 inches, very pale brown (10YR 8/3) silt loam, pale brown (10YR 6/3) when moist; few scattered pebbles; structureless; soft when dry, very friable when moist; highly calcareous; abrupt, wavy boundary.

IIC—36 to 46 inches, mixed, calcareous, fine and medium Pleistocene gravel that is waterworn and rounded.

A noticeable amount of small pebbles is scattered on the surface. The A1 horizon ranges from about 4 to 8 inches in thickness. The B21 claypan horizon is silty clay loam to clay. The B22 horizon ranges from about 3 to 8 inches in thickness. In some places lime accumulates in the B22 horizon, and in many places it extends well into the C horizon. The depth of leaching ranges from about 14 to 21 inches. The A2 horizon is only weakly defined in some places.

DIX SERIES

The Dix series consists of shallow, excessively drained Chestnut soils of the uplands that intergrade toward Regosols. These zonal soils occupy complex steep slopes and are on high remnants of gravelly terraces or alluvial fans. They are underlain by waterworn Pleistocene gravel at a depth of 10 to 20 inches. The solum and upper beds of gravel are leached of lime. The Dix soils are more shallow and less well developed than the Altvan and Chappell soils and contain more gravel and less clay in their subsoil. They occupy about the same kinds of position as do Canyon soils but developed in Pleistocene gravel instead of Tertiary sandstone.

Profile of Dix gravelly sandy loam (about 0.2 mile north and 250 feet west of the southeast corner of sec. 9, T. 13 N., R. 45 W.; native grassland):

A1—0 to 5 inches, grayish-brown (10YR 5/2) gravelly sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

B—5 to 18 inches, dark grayish-brown or grayish-brown (10YR 4.5/2) light gravelly loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; gradual, wavy boundary.

IIC—18 to 24 inches, noncalcareous, waterworn, mixed sand and gravel; structureless; loose when dry or moist.

The A horizon ranges from gravelly sandy loam to gravelly loam and is 4 to 7 inches thick. The B horizon is very weakly defined to well defined. The thickness of the subsoil ranges from about 6 to 13 inches. A thin C horizon occurs above the gravel layer in some places. The thickness of the solum over Pleistocene sand and gravel ranges from 10 to 20 inches. Lime coated pebbles normally occur at depths of 2 to 3 feet, but in some places they are missing.

DUNDAY SERIES

The Dunday soils consist of deep, sandy Regosols on uplands and high terraces. These azonal soils have a darkened A horizon, are noncalcareous, and are excessively drained. They formed in eolian sands on low slopes and swales within and along the sandhills. Dunday soils have a darker, thicker A horizon than Valentine soils and are not so sandy. They are sandier and less coherent than the Anselmo soils.

Profile of Dunday loamy fine sand (about 0.3 mile west and 50 feet north of the southeast corner of sec. 31, T. 13 N., R. 44 W.; native grassland):

A1—0 to 8 inches, grayish-brown (10YR 5/2) loamy fine sand, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

AC—8 to 13 inches, grayish-brown or light brownish-gray (10YR 5.5/2) fine sand, dark grayish brown or grayish brown (10YR 4.5/2) when moist; structureless; loose when dry, loose when moist; noncalcareous; gradual, smooth boundary.

C—13 to 27 inches, pale-brown (10YR 6/3) fine sand; brown (10YR 5/3) when moist; structureless; loose when dry, loose when moist; noncalcareous.

The A horizon ranges from about 6 to 11 inches in thickness and from loamy fine sand to fine sand in texture. Silty material is at a depth of about 30 inches in some places.

GOSHEN SERIES

In the Goshen series are deep, very dark colored Chestnut soils. These zonal soils formed on mixed deposits of loess and silty colluvium and alluvium. They are in narrow valleys of upland drainageways on nearly level to very gentle slopes and are in well-drained swales or basins on the tablelands. Goshen soils have a much thicker and darker surface horizon than the Bridgeport soils, are more deeply leached of lime, and contain much more clay in their subsoil. The dark part of the profile is thicker than that in the Keith, Richfield, Kuma, and Rosebud soils, and calcium carbonate is more deeply leached.

Profile of Goshen silt loam (about 0.35 mile north and 70 feet east of the southwest corner of sec. 5, T. 13 N., R. 44 W.; fallow cropland):

A1p—0 to 8 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A12—8 to 17 inches, dark-gray or gray (10YR 4.5/1) silt loam, black or very dark brown (10YR 2/1.5) when moist; weak, coarse, blocky structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B21—17 to 28 inches, grayish-brown (10YR 5/2) silty clay loam, very dark brown (10YR 2/2) when moist; moderate, coarse, prismatic structure breaking to strong, fine, subangular blocky structure; hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B22—28 to 36 inches, grayish-brown or light brownish-gray (10YR 5.5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, coarse, prismatic structure breaking to weak, fine and medium, subangular blocky structure; hard when

dry, friable when moist; noncalcareous; clear, smooth boundary.

B23—36 to 48 inches, grayish-brown (10YR 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, fine and medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B3—48 to 56 inches, light brownish-gray (10YR 6/2) silt loam; very dark grayish brown or dark grayish brown (10YR 3.5/2) when moist; weak, coarse, prismatic structure; slightly hard when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

C—56 to 62 inches, very pale brown (10YR 7/3) silt loam, dark brown or brown (10YR 4.5/3) when moist; structureless; soft when dry, very friable when moist; noncalcareous.

The A horizon ranges from about 10 to 24 inches in thickness. It is silt loam to fine sandy loam. The B horizon ranges from about 25 to 40 inches in thickness and is black to very dark grayish brown. It is silt loam to silty clay loam. Structure of the B horizon is weak to strong. The solum is 40 to 60 inches thick over light-colored, silty parent material.

HAVRE SERIES

The Havre series consists of light-colored, calcareous Alluvial soils that are medium textured and well drained. In Deuel County these soils are on high bottoms or low terraces. Although the Havre soils have little horizonation, there is some stratification below the A1 horizon. The Havre soils occur closely with the Bridgeport soils and are somewhat similar to them. Only a small acreage of Havre soils occurs in Deuel County.

Profile of Havre loam:

A1p—0 to 7 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; calcareous; abrupt boundary.

C—7 to 40 inches, light brownish-gray (10YR 6/2) stratified loam, silt loam, and very fine sandy loam, grayish brown (10YR 5/2) when moist; massive (structureless) to weak, coarse, blocky structure; soft when dry, very friable when moist; calcareous.

The A horizon is 5 to 10 inches thick. The C horizon is 20 inches or more thick.

KEITH SERIES

The Keith series consists of Chestnut soils that developed in Peorian loess on the uplands. These well-drained zonal soils are extensive in Deuel County and occur in wide areas throughout the tablelands. In most places they are low lying, but slopes range from 0 to 9 percent. Keith soils have a thicker solum than Richfield soils and are not so clayey or so well developed in their B horizon. They are not so dark or so deeply leached of lime as the Kuma and Goshen soils. Keith soils are deeper and somewhat more mature than Rosebud soils and formed in loess instead of residual Tertiary sandstone. They have a thicker, darker A horizon and a thicker solum than have Ulysses and Colby soils, and the lime zone is at a greater depth.

Profile of Keith silt loam (about 0.1 mile south and 150 feet east of the northwest corner of the SW¼ of sec. 24, T. 14 N., R. 45 W.; field of sorghum):

A1p—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark brown or very dark grayish brown (10YR 2.5/2) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A12—7 to 11 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) when moist; weak, coarse, blocky structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B21—11 to 14 inches, light brownish-gray (10YR 6/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure; hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B22—14 to 26 inches, light brownish-gray (10YR 6/2) light silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure; hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B3ca—26 to 31 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; slightly hard when dry, very friable when moist; highly calcareous; clear, smooth boundary.

C—31 to 40 inches, light-gray (10YR 7/2) silt loam, brown or pale brown (10YR 5.5/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous.

The A horizon ranges from about 6 to 12 inches in thickness. It is silt loam, loam, or fine sandy loam. The B horizon ranges from silt loam or silty clay loam to light sandy clay loam or light clay loam. It is 15 to 20 inches thick. The lower part of the B horizon is noncalcareous in some places.

KUMA SERIES

In the Kuma series are Chestnut soils that developed in loess on uplands. The presence of dark-colored Paleosols within or below the solum of these soils indicates that at least two periods of deposition occurred. These well-drained, "two-story" soils occur throughout the tablelands on nearly level slopes. Kuma soils have a thicker solum than have the Keith or Richfield soils, but the B horizon is similarly developed, although it is darker colored in the lower part. Kuma soils are not so deeply leached of lime as the Goshen soils. They are deeper and more mature than Rosebud soils and formed in loess instead of residuum of sandstone.

Profile of Kuma silt loam (about 0.3 mile north and 100 feet west of the southeast corner of sec. 11, T. 13 N., R. 44 W.; fallow cropland):

A1p—0 to 7 inches, grayish-brown or light brownish-gray (10YR 5.5/2) silt loam, very dark brown or very dark grayish brown (10YR 2.5/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A12—7 to 11 inches, grayish-brown (10YR 5/2) silt loam, very dark brown (10YR 2/2) when moist; weak, coarse, blocky structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B21t—11 to 18 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to weak, fine and medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B2bt—18 to 33 inches, dark-gray or gray (10YR 4.5/1) silty clay loam, black (10YR 2/1) when moist; moderate, coarse, prismatic structure breaking to moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B3b—33 to 46 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

C—46 to 54 inches, very pale brown (10YR 7/3) silt loam, brown or pale brown (10YR 5.5/3) when moist;

structureless; soft when dry, very friable when moist; highly calcareous; abrupt, wavy boundary.
IIC2—54 to 60 inches, highly calcareous gravel; structureless; loose.

The B horizon ranges from 12 to 24 inches in thickness. The dark-colored Paleosols are normally 5 to 15 inches thick. Depth to lime is 3 to 4 feet. In some places these soils are underlain by gravel at a depth of about 50 inches.

LAS SERIES

The Las series consists of deep, imperfectly drained, dark-colored soils of the bottom lands. These calcareous Alluvial soils are nearly level and are developing in moderately fine textured sediments. They occur principally along the South Platte River but are also along Lodgepole Creek. They are underlain by water-bearing sand or sand and gravel at a depth of 2½ to 4 feet. Las soils are darker colored and deeper over sand and gravel than the Las Animas soils and have finer textured parent materials. They are not so well drained as the Bayard soils and have a finer textured C horizon. Las soils contain more clay in their parent materials than the Wann soils and are not so strongly saline or alkaline as are Slickspots or Laurel soils.

Profile of Las loam (about 0.2 mile north and 200 feet west of the southeast corner of sec. 16, T. 12 N., R. 43 W.; native grassland):

A11—0 to 4 inches, gray (10YR 5/1) loam, black (10YR 2/1) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; pH 7.2; 0.09 percent soluble salts; clear, smooth boundary.
A12—4 to 6 inches, gray (10YR 5/1) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, granular structure; slightly hard when dry, very friable when moist; noncalcareous; pH 8.3; 0.40 percent soluble salts; clear, smooth boundary.
C1—6 to 11 inches, light brownish-gray (10YR 6/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to medium, subangular, blocky structure; hard when dry, friable when moist; highly calcareous; pH 9.2; 0.45 percent soluble salts; clear, smooth boundary.
C2—11 to 19 inches, light-gray (10YR 7/2) silty clay loam, dark grayish brown (10YR 4/2) when moist; structureless; slightly hard when dry, friable when moist; highly calcareous; pH 9.3; 0.39 percent soluble salts; clear, smooth boundary.
C3—19 to 31 inches, white (10YR 8/1) silty clay loam, gray (10YR 5.5/1) when moist; structureless; slightly hard when dry, friable when moist; highly calcareous; pH 8.9; 0.26 percent soluble salts; abrupt, smooth boundary.
IIC4—31 to 35 inches, pale-brown (10YR 6/3) loamy fine sand, dark grayish brown (10YR 4/2) when moist; structureless; slightly hard when dry, friable when moist; highly calcareous; pH 9.0; 0.08 percent soluble salts; stained with brown iron stains; some hard concretions of carbonate; abrupt, smooth boundary.
IIC5—35 to 45 inches, light-gray (2.5Y 7/2) fine sand, grayish brown (2.5Y 5/2) when moist; structureless; slightly hard when dry, loose when moist; highly calcareous; pH 8.6; 0.08 percent soluble salts.

The A horizon ranges from black to very dark grayish brown in color and from 6 to 14 inches in thickness. Stratification of the alluvial parent material ranges from little to much. This material is from 20 to 35 inches thick over iron-stained sand or mixed sand and gravel. It is dark grayish brown to gray and ranges from loam to silty clay loam, sandy clay loam, or clay loam. These soils are mostly slightly saline or alkaline in local areas. In some places the surface layer is noncalcareous to a depth of a few inches.

LAS ANIMAS SERIES

The Las Animas series consists of moderately deep, imperfectly drained, sandy Alluvial soils of the bottom lands along the South Platte River and Lodgepole Creek. These calcareous azonal soils are underlain by water-bearing sand and gravel at a depth of 20 to 36 inches. They are nearly level and very gently sloping. Las Animas soils are lighter colored and more shallow than the Las soils and have a sandier profile. They are similar to Wann soils, but are more shallow, are sandier, and contain more gravel in the lower part of the profile.

Profile of Las Animas fine sandy loam (about 30 feet north of the creek and 30 feet west of the road in the southeast corner of sec. 26, T. 13 N., R. 45 W.; native grassland):

A1—0 to 7 inches, grayish-brown (10YR 5/2) heavy fine sandy loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; highly calcareous; pH 7.7; less than 0.07 percent soluble salts; abrupt boundary.
C1—7 to 13 inches, light brownish-gray (10YR 6/2) gravelly loamy sand, dark grayish brown (10YR 4/2) when moist; structureless; loose when dry, very friable when moist; highly calcareous; pH 8.2; less than 0.07 percent soluble salts; clear, smooth boundary.
C2—13 to 23 inches, light brownish-gray or light gray (10YR 6.5/2) loamy sand, dark grayish brown or grayish brown (10YR 4.5/2) when moist; structureless; soft when dry, very friable when moist; highly calcareous; pH 8.9; less than 0.07 percent soluble salts; clear, smooth boundary.
C3—23 to 30 inches, light-gray (10YR 7/2) fine sandy loam, grayish brown (10YR 5/2) when moist; structureless; slightly hard when dry, very friable when moist; highly calcareous; pH 8.9; less than 0.07 percent soluble salts; abrupt, smooth boundary.
IIC4—30 to 40 inches, mixed sand and fine gravel; a few pebbles 1 inch in diameter; free water at 34 inches; pH 8.2; less than 0.07 percent soluble salts.

The A horizon ranges from 6 to 16 inches in thickness. It ranges from very dark brown in some areas of the fine sandy loam to grayish brown in areas of the loamy sand. The surface layer is loam in a few places. Lime has been leached from the surface layer in some of the loamy sand. The depth to the underlying loose sand and gravel ranges from 20 to 36 inches. Stratification in the profiles ranges from little to much; strata that range from loam to gravel are common. In some places the Las Animas series are underlain by water-bearing sand that contains only a little gravel. Las Animas soils are moderately alkaline in some places.

LAUREL SERIES

In the Laurel series are dark-colored, poorly drained Solonchak soils of the bottom lands. These intrazonal soils developed in fine-textured alluvium that has a high content of soluble salts. They are in small areas on the bottom lands of Lodgepole Creek and the South Platte River on nearly level slopes that are slightly concave. Laurel soils contain more sodium and are more highly alkaline than the Nunn or Las soils and are finer textured and less well drained. They are more stratified than Slickspots and Nunn soils and are more variable in their characteristics.

Profile of Laurel loam (about the center of the SW¼ of sec. 31, T. 13 N., R. 41 W.; irrigated field of sugar beets):

A1p—0 to 5 inches, dark-gray or gray (10YR 4.5/1) loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; highly calcareous; pH 9.2; less than 0.07 percent soluble salts; abrupt, smooth boundary.

A12—5 to 12 inches, dark-gray or gray (10YR 4.5/1) loam, black (10YR 2/1) when moist; weak, coarse, blocky structure; soft when dry, very friable when moist; highly calcareous; pH 9.2; less than 0.07 percent soluble salts; clear, smooth boundary.

AC—12 to 17 inches, dark-gray (10YR 4/1) clay loam, black (10YR 2/1) when moist; weak, coarse, blocky structure; hard when dry, friable when moist; highly calcareous; pH 10.0; 0.11 percent soluble salts; clear, smooth boundary.

C1—17 to 25 inches, grayish-brown (10YR 5/2) clay loam, very dark grayish brown or dark grayish brown (10YR 3.5/2) when moist; structureless; hard when dry, friable when moist; highly calcareous; pH 10.0; 0.26 percent soluble salts; clear, smooth boundary.

C2—25 to 32 inches, light brownish-gray or light-gray (10YR 6.5/2) sandy clay loam, dark grayish brown (10YR 4/2) when moist; structureless; hard when dry, friable when moist; highly calcareous; pH 10.1; 0.24 percent soluble salts; abrupt, smooth boundary.

C3—32 to 36 inches, gray (10YR 6/1) heavy silty clay loam, very dark gray (10YR 3/1) when moist; structureless; hard when dry, firm when moist; highly calcareous; pH 9.9; 0.42 percent soluble salts; abrupt, smooth boundary.

C4—36 to 45 inches, dark-gray or gray (10YR 4.5/1) clay; black (10YR 2/1) when moist; structureless; hard when dry, firm when moist; highly calcareous; pH 9.8; 0.28 percent soluble salts; abrupt, smooth boundary.

C5—45 to 60 inches, very pale brown (10YR 7/3) sand, pale brown (10YR 6/3) when moist; structureless; loose when dry, loose when moist; noncalcareous; pH 9.8; 0.08 percent soluble salts; water table 45 inches from surface.

The A horizon ranges from black to dark grayish brown in color and from about 6 to 16 inches in thickness. The AC horizon is missing in some places. The stratified layers in the C horizon range from black to gray in color and from clay to loam in texture. In some places a few thin strata of sandy loam or loamy sand occur between layers of finer textured materials. Enough soluble salts and sodium occur to damage plants, and in places only the most alkali-tolerant plants survive.

NUNN SERIES

The Nunn series consists of deep, dark, silty Chestnut soils on low stream terraces. The parent material of old alluvium contains small amounts of sodium and soluble salts. These moderately well drained soils are nearly level. They are slightly lower on terraces than are the Tripp and Keith soils and have a thicker profile, a more clayey B horizon, and poorer drainage. The Nunn soils are thicker and better drained than Slickspots and are not so saline or alkali.

Profile of Nunn silt loam (about 840 feet west and 30 feet north of the southeast corner of sec. 3, T. 12 N., R. 42 W.; irrigated cornfield):

A1p—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; pH 7.4; less than 0.07 percent soluble salts; abrupt, smooth boundary.

A3—7 to 11 inches, gray (10YR 5/1) silty clay loam, very dark brown (10YR 2/2) when moist; weak, medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; pH 7.1; less than 0.07 percent soluble salts; abrupt, smooth boundary.

B21—11 to 20 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; horizon of maximum clay accumulation; weak, coarse, prismatic structure breaking to moderate, fine, subangular blocky structure; hard when dry, friable when moist; noncalcareous; pH 7.1; less than 0.07 percent soluble salts; abrupt, smooth boundary.

B22—20 to 30 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, fine, subangular blocky structure; hard when dry, friable when moist; slightly calcareous; pH 8.0; 0.10 percent soluble salts; abrupt, smooth boundary.

B23—30 to 42 inches, gray (10YR 5/1) silty clay loam, very dark grayish brown (10YR 3/2) when moist; visible salts; weak, coarse, prismatic structure; hard when dry, friable when moist; highly calcareous; pH 8.3; less than 0.07 percent soluble salts; abrupt boundary.

B3—42 to 50 inches, gray (10YR 5/1) heavy silt loam, very dark grayish brown (10YR 3/2) when moist; visible salts; weak, coarse, prismatic structure; hard when dry, friable when moist; highly calcareous; pH 8.5; less than 0.07 percent soluble salts; abrupt, smooth boundary.

C—50 to 60 inches, light-gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) when moist; structureless; soft when dry, very friable when moist; highly calcareous; pH 8.5; less than 0.07 percent soluble salts.

The A horizon ranges from 8 to 16 inches in thickness and from heavy silt loam to loam in texture. The upper part of the subsoil is more compact and finer textured than the lower part and ranges from silty clay loam to clay loam or sandy clay loam. The B horizon ranges from about 20 to 40 inches in thickness. In some places the Nunn soils are underlain by calcareous, sandy alluvial material.

RICHFIELD SERIES

In the Richfield series are Chestnut soils that developed in loess on nearly level to very gently sloping uplands. In Deuel County these zonal soils occur throughout the tablelands and are closely associated with Keith and Kuma soils. Richfield soils have a thinner solum than the Kuma soils. They contain more clay in their B horizon and are more strongly developed than Keith soils. Richfield soils are not so dark or so deeply leached of lime as are the Goshen soils. They are deeper and more mature than Rosebud soils and developed in loess instead of residuum of Tertiary sandstone.

Profile of Richfield silt loam (about 0.35 mile north and 40 feet west of the southeast corner of sec. 13, T. 13 N., R 44 W.; fallow cropland):

A1p—0 to 6 inches, grayish-bown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

B1—6 to 11 inches, grayish-brown (10YR 5/2) silty clay loam, very dark brown or very dark grayish brown (10YR 2.5/2) when moist; moderate, coarse, blocky structure; hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B2t—11 to 18 inches, grayish-brown (10YR 5/2) silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, coarse, prismatic structure breaking to moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; clear, smooth boundary.

B3—18 to 23 inches, light brownish-gray or pale-brown (10YR 6/2.5) silt loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

Cca—23 to 32 inches, light-gray (10YR 7/2) silt loam, pale brown (10YR 6/3) when moist; structureless; slightly hard when dry, very friable when moist; highly calcareous; gradual, smooth boundary.

C2—32 to 40 inches, light-gray (10YR 7/2) silt loam, brown or pale brown (10YR 5.5/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous.

The A horizon ranges from 5 to 8 inches in thickness and from silt loam to loam in texture. The B horizon is 12 to 19 inches thick. The B3 horizon is calcareous in some places. The B horizon ranges from dark brown or very dark grayish brown in the B1 and B2 horizons to dark grayish brown in the B3 horizon. Texture ranges from silty clay loam to clay loam in the B1 and B2 horizons to silt loam in the B3. Structure is moderate in the B2 horizon and is weak in the B3 horizon.

ROSEBUD SERIES

In the Rosebud series are Chestnut soils of the uplands. These soils developed in place on highly calcareous residuum of sandstone. Loess has been added to the parent material. These deep and moderately deep soils are mostly on undulating slopes throughout the tablelands but occur on complex slopes ranging from nearly level to hilly. Rosebud soils are not so deep or mature as Keith, Kuma, or Richfield soils, but they are more sandy and formed in mixed loess and limy sandstone instead of loess. The Rosebud soils are deeper over limy sandstone than the Canyon soils.

Profile of Rosebud loam (about 0.1 mile north and 100 feet east of the southwest corner of sec. 12, T. 14 N., R. 46 W.; field of safflower):

A1p—0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; the lower inch is compacted into a plowpan that has platy structure; soft when dry, very friable when moist; noncalcareous; pH 8.0; abrupt, smooth boundary.

B2t—6 to 14 inches, dark grayish-brown (10YR 4/2) clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure breaking to moderate, medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous; pH 7.7; clear, smooth boundary.

B3ca—14 to 24 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist; highly calcareous; pH 8.5; gradual, smooth boundary.

C1—24 to 32 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure to structureless; slightly hard when dry, friable when moist; highly calcareous; pH 8.5; gradual, smooth boundary.

C2—32 to 36 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; structureless; slightly hard when dry, friable when moist; highly calcareous; pH 8.8; clear, wavy boundary.

R—36 to 40 inches, pink (7.5YR 7/4) highly calcareous sandstone, light brown (7.5YR 6/4) when moist.

SCOTT SERIES

Soils of the Scott series are Planosols in depressions of the uplands. These intrazonal soils occur on the tablelands in undrained basins or potholes that hold accumulated runoff water until it disappears slowly through seepage and evaporation. The Scott soils developed in loess or loesslike material. They are dark colored and slowly permeable. Scott soils are darker colored and finer textured than the Dawes soils and are less well drained. They have a much thicker claypan subsoil than Dawes soils and are free of lime.

Profile of Scott silty clay loam (about 0.25 mile east and 350 feet north of the southwest corner of sec. 25, T. 14 N., R. 43 W.; field of sorghum):

A1p—0 to 7 inches, gray or light-gray (10YR 5.5/1) light silty clay loam, very dark brown (10YR 2/2) when moist; weak, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

A2—7 to 8 inches, light-gray (10YR 6/1) silt loam, very dark gray (10YR 3/1) when moist; weak, thin, platy structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.

B21t—8 to 21 inches, gray (10YR 5/1) silty clay, black or very dark gray (10YR 2.5/1) when moist; weak, coarse, prismatic structure; hard when dry, firm when moist; noncalcareous; clear, smooth boundary.

B22t—21 to 29 inches, gray (10YR 5/1) silty clay, very dark gray or gray (10YR 3.5/1) when moist; weak, coarse, prismatic structure; hard when dry, firm when moist; noncalcareous; clear, smooth boundary.

B23—29 to 38 inches, light brownish-gray (10YR 6/2) silty clay, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure; hard when dry, firm when moist; noncalcareous; clear, smooth boundary.

C—38 to 48 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; structureless; soft when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

IIC2—48 to 60 inches, very pale brown (10YR 7/4) fine sandy loam, yellowish brown (10YR 5/4) when moist; structureless; soft when dry, very friable when moist; noncalcareous.

The surface layer is cloddy in some places. The A horizon ranges from 3 to 8 inches in thickness and from silty clay loam to silt loam or loam in texture. The A2 horizon is indistinct or missing in some places but is as much as 3 inches thick in others. The claypan B horizon ranges from 2 to 6 feet or more in thickness.

TRIPP SERIES

The Tripp series consists of deep, dark, silty Chestnut soils of the stream terraces and uplands. These well-drained zonal soils are nearly level to rolling. They developed in old silty alluvium and loess. Tripp soils contain more sand and less silt and clay than Keith soils and have less horizonation. They are deeper than Cheyenne soils and have silty instead of sandy and gravelly underlying materials. The Tripp soils are not so thick as the Nunn soils and have a less clayey subsoil. Unlike the Nunn soils, Tripp soils do not contain soluble salts. They are siltier and better developed than the Bayard soils. Tripp soils occur with Bridgeport soils and are darker colored, more silty, less limy, and better developed.

Profile of Tripp loam (about 0.25 mile south and 20 feet east of the northwest corner of the NE¼ of sec. 9, T. 12 N., R. 42 W.; cornfield):

A1p—0 to 10 inches, gray or grayish-brown (10YR 5/1.5) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

A12—10 to 14 inches, gray (10YR 5/1) loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, blocky structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B1—14 to 19 inches, gray or grayish-brown (10YR 5/1.5) loam, dark grayish brown or very dark grayish brown (10YR 3.5/2) when moist; weak, coarse, prismatic structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B2—19 to 36 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure; slightly hard when dry, very friable when moist; generally noncalcareous but contains a few small spots of visible calcium carbonate in the lower part; clear, smooth boundary.

C—36 to 50 inches, light brownish-gray (10YR 6/2) light loam, dark grayish brown (10YR 4/2) when moist; structureless; soft when dry, very friable when moist; slightly calcareous; calcium carbonate that is concentrated in spots.

Some fine gravel occurs on the surface, and a small amount is in the profile. The A horizon ranges from about 7 to 14 inches in thickness. It is silt loam, loam, or fine sandy loam. The B horizon ranges from about 15 to 30 inches in thickness and is silt loam, light silty clay loam, or sandy clay loam. The zone of lime accumulation is in the B3 horizon or in the upper part of the C horizon. In some places coarser sediments underlie the Tripp soils at a depth of about 40 inches.

ULYSSES SERIES

The Ulysses series consists of Chestnut soils that intergrade toward Regosols. These soils developed in thick deposits of loess, mainly in hilly areas on convex or smooth side slopes. They are darker than the Colby soils and are noncalcareous to a slightly greater depth. Ulysses soils occur with Keith soils and are more calcareous and not so well developed.

Profile of Ulysses silt loam (about 200 feet south and 75 feet west of the northeast corner of the NW¼ of sec. 6, T. 14 N., R. 41 W.; native grassland):

A1—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.

AC or B—6 to 11 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; some pockets of very dark grayish-brown (10YR 3/2, moist) silt loam; weak, medium, prismatic structure; soft when dry, very friable when moist; highly calcareous; clear, smooth boundary.

C1—11 to 18 inches, very pale brown (10YR 7/3) very fine sandy loam, brown or pale brown (10YR 5.5/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.

C2—18 to 36 inches, very pale brown (10YR 8/3) very fine sandy loam; grayish brown or brown (10YR 5.5/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous.

The A horizon ranges from 5 to 15 inches in thickness and, when moist, from very dark grayish brown to dark grayish brown in color. The subsoil horizon is a darkened AC horizon or a very weakly developed textural B horizon. Depth to calcareous material ranges from about 5 to 15 inches. The C horizon consists of silty or only slightly sandy loess.

VALENTINE SERIES

The Valentine series consists of deep, light-colored Regosols that developed in noncalcareous eolian sands on smooth to choppy hummocky slopes. These young soils have a darkened surface horizon but are otherwise undeveloped. Valentine soils are lighter colored than the Anselmo soils and are more sandy and less coherent. They have a thinner A horizon than Dunday soils and are slightly sandier and on steeper slopes.

Profile of Valentine fine sand (about 0.3 mile north and 0.15 mile east of the southwest corner of sec. 16, T. 12 N., R. 44 W.; native grassland):

A1—0 to 5 inches, grayish-brown (10YR 5/2) fine sand, very dark grayish brown or dark grayish brown (10YR 3.5/2) when moist; weak, fine, granular structure; loose when dry, loose when moist; noncalcareous; abrupt, smooth boundary.

C—5 to 40 inches, pale-brown (10YR 6/3) fine sand, dark brown (10YR 4/3) when moist; structureless; loose when dry, loose when moist; noncalcareous.

The darkened A horizon ranges from 1 to 7 inches in thickness. It is loamy sand to fine sand. In some places Valentine soils have a slightly darkened AC horizon that is as much as 8 inches thick.

WANN SERIES

In the Wann series are dark, calcareous Alluvial soils of the imperfectly drained bottom lands. These immature soils are developing in moderately sandy sediments on nearly level, channeled slopes. They are underlain by gravel at a depth of 30 to 40 inches. The Wann soils have a sandier subsoil than Las soils and are deeper over gravel beds and have a more coherent subsoil than Las Animas soils.

Profile of Wann loam (about 0.3 mile north and 150 feet west of the southeast corner of the NE¼ of sec. 31, T. 13 N., R. 41 W.; cornfield):

A1p—0 to 8 inches, gray (10YR 5.5/1) loam, very dark gray (10YR 3/1) when moist; weak, fine, granular structure in upper 6 inches and weak, coarse, blocky structure below; soft when dry, very friable when moist; highly calcareous; lower 2 inches contains a few white visible salts; pH 7.3; 0.12 percent soluble salts; abrupt, smooth boundary.

A12—8 to 17 inches, gray (10YR 5.5/1) very fine sandy loam, very dark brown (10YR 2/2) when moist; weak, coarse, blocky structure; soft when dry, very friable when moist; highly calcareous; pH 7.7; 0.08 percent soluble salts; clear, smooth boundary.

C1—17 to 31 inches, grayish-brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) when moist; structureless; slightly hard when dry, very friable when moist; noncalcareous; pH 6.5; 0.10 percent soluble salts; clear, smooth boundary.

C2—31 to 36 inches, light brownish-gray (2.5Y 6/2) sandy clay loam, dark grayish brown (2.5Y 4/2) when moist; structureless; hard when dry, firm when moist; noncalcareous; highly stained brown with iron; pH 6.5; 0.11 percent soluble salts; clear, smooth boundary.

C3—36 to 42 inches, light-gray (2.5Y 7/2) sand, grayish brown (2.5Y 5/2) when moist; high in mica; structureless; loose when dry, loose when moist; noncalcareous; pH 6.3; 0.08 percent soluble salts; abrupt, smooth boundary.

IIC4—42 to 50 inches, mixed sand and gravel; loose when dry, loose when moist; noncalcareous; pH 6.6; less than 0.07 percent soluble salts.

The A horizon ranges from 6 to 18 inches in thickness and from black to very dark grayish brown in color. It is silt loam to very fine sandy loam. An AC horizon occurs in many places and ranges from 4 to 8 inches in thickness. It is very fine sandy loam to sandy loam. The C horizon is sandy loam to sand, considerably stratified.

A few thin, finer textured strata occur in some places. The gravelly IIC4 horizon occurs at about 30 to 40 inches below the surface. The water table is at a depth of 20 to 40 inches.

Mechanical and Chemical Analyses

In table 11 are data obtained by mechanical and chemical analyses of some selected soils in Deuel County. The profiles of these soils are described in this subsection.

The data in table 11 are useful to soil scientists in classifying soils and in developing concepts of soil formation. They are also helpful in estimating water-holding capacity, wind erosion, fertility, tilth, and other characteristics that affect soil management. The data on reaction, electrical conductivity, and percentage of exchangeable sodium are helpful in evaluating the possibility of reclaiming and managing saline-alkali areas.

Field and laboratory methods

All samples used to obtain the data in table 11 were collected from carefully selected pits. The samples are considered representative of the soil material that is made up of particles less than ¾ inch in diameter. Estimates of the fraction of the sample consisting of particles larger than ¾ inch were made during the sampling. If necessary, the sample was sieved after it was dried and rock fragments larger than ¾ inch in diameter were discarded. Then the material made up of particles less than ¾ inch was rolled, crushed, and sieved by hand to remove rock fragments larger than 2 millimeters in diameter. The fraction that consists of particles between 2 millimeters and ¾ inch in diameter is recorded on the data sheets and in table 11 as the percent greater than 2 millimeters. This value is calculated from the total weight of the particles smaller than ¾ inch in diameter.

The estimates for the fractions that consist of particles larger than ¾ inch and of particles between 2 millimeters and ¾ inch are somewhat arbitrary. The accuracy of the data depends on the severity of the preparative treatment, which may vary with the objectives of the study. But it can be said that the two fractions contain relatively unaltered rock fragments that are larger than 2 millimeters in diameter and that they do not contain slakeable clods of earthly material.

Unless otherwise noted, all laboratory analyses are made on material that passes the 2-millimeter sieve and are reported on an oven-dry basis. In table 11, values for exchangeable sodium and potassium are for amounts of sodium and potassium that have been extracted by the ammonium acetate method minus the amounts that are soluble in the saturation extract.

Standard methods of the Soil Survey Laboratory were used to obtain most of the data in table 11. Determinations of clay were made by the pipette method (*8*, *9*, *13*). The reaction was measured with a glass electrode. Organic carbon was determined by wet combustion, using a modification of the Walkley-Black method (*14*). The calcium carbonate equivalent was determined by measuring the volume of carbon dioxide emitted from soil samples treated with concentrated hydrochloric acid. The cation exchange capacity was determined by direct distillation of adsorbed ammonia (*14*). Extractable sodium and potassium were determined on original extracts with a flame spectrophotometer. Exchangeable sodium percentage is the relation of exchangeable sodium to the cation exchange capacity, expressed in percent. The methods of the U.S. Salinity Laboratory were used to obtain the saturation extract. Soluble sodium and potassium in the saturation extract were determined with a flame spectrophotometer (*16*).

Descriptions of soils analyzed

The profiles of the soils listed in table 11 are described in the following pages.

Dawes loam (S–58–Nebr–25–3(1–7)): Located about 0.2 mile east and 180 feet south of the northwest corner of sec. 4, T. 12 N., R. 45 W.; approximately 3 miles south and 1 mile east of Chappell, Nebr.

- A1p—0 to 6 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.
- A2—6 to 8 inches, gray (10YR 6.5/1 very fine sandy loam, dark gray (10YR 4/1) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.
- B2t—8 to 16 inches, dark grayish-brown (10YR 3.5/2) silty clay loam, very dark brown (10YR 2/2) when moist; moderate, medium and coarse, columnar structure breaking to moderate, fine and medium, blocky structure; hard when dry, firm when moist; noncalcareous; clear, smooth boundary.
- B3—16 to 24 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.
- C1—24 to 32 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.
- C2—32 to 40 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous; abrupt, smooth boundary.
- IIC3—40 to 51 inches, fine to coarse, well-rounded Pleistocene gravel.

Pebbles are scattered throughout the profile.

Dawes loam (S–58–Nebr–25–4(1–7)): Located about 0.2 mile south and 180 feet west of the northeast corner of sec. 6, T. 12 N., R. 45 W.; approximately 3.5 miles south and 0.5 mile west of Chappell, Nebr.

- A1p—0 to 5 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.
- A2—5 to 7 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.
- B2t—7 to 14 inches, very dark grayish-brown (10YR 3/2) silty clay loam, very dark brown (10YR 2/2) when moist; moderate, medium and coarse, columnar structure breaking to moderate, fine and medium, blocky structure; hard when dry, firm when moist; noncalcareous; clear, smooth boundary.
- B3—14 to 17 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.

TABLE 11.—*Analytical data on some*

[Analysis by Soil Survey Laboratory, SCS, Lincoln,

Soil type and sample number	Depth	Horizon	Mechanical analysis: Particle size distribution — Very coarse sand (2.0–1.0 mm.)	Coarse sand (1.0–0.5 mm.)	Medium sand (0.5–0.25 mm.)	Fine sand (0.25–0.10 mm.)	Very fine sand (0.10–0.05 mm.)	Total sand (2.0–0.05 mm.)	Silt (0.05–0.002 mm.)	Clay (less than 0.002 mm.)	Larger than 2 mm.[1]	Texture
	Inches		*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	
Dawes loam: S-58-Nebr-25-3(1-7).	0-6	A1p	6.4	6.3	3.2	3.9	15.0	34.8	49.7	15.5	12.2	Loam to silt loam.
	6-8	A2	3.7	3.8	2.1	2.9	14.1	26.6	58.8	14.6	(3)	Silt loam.
	8-16	B2t	.6	.9	.4	1.0	10.2	13.1	45.8	41.1	(3)	Silty clay.
	16-24	B3	.2	.3	.2	.7	16.8	18.2	61.3	20.5	(4)	Silt loam.
	24-32	C1	.1	.3	[5] .2	[5] .8	[5] 22.1	23.5	62.4	14.1	(4)	Silt loam.
	32-40	C2	2.6	[5] 2.4	[5] 1.7	[5] 2.9	[5] 26.3	35.9	51.0	13.1	(4)	Silt loam.
	40-51	IIC3	42.2	35.6	11.9	6.3	.2	96.2	1.3	2.5	26.8	Coarse sand.
Dawes loam: S-58-Nebr-25-4(1-7).	0-5	A1p	3.4	3.5	2.3	3.4	14.5	27.1	55.3	17.6	9.9	Silt loam.
	5-7	A2	4.2	3.6	2.6	4.0	15.3	29.7	57.7	12.6	(3)	Silt loam.
	7-14	B2t	.6	.7	.5	1.1	8.5	11.4	38.8	49.8	(4)	Clay.
	14-17	B3	.3	.4	[5] .2	[5] .8	[5] 13.9	15.6	62.9	21.5	(4)	Silt loam.
	17-25	C1	.1	.3	[6] .2	[6] 1.0	[6] 20.4	22.0	65.2	12.8	(4)	Silt loam.
	25-33	C2	[6] 1.1	.7	[6] .5	[6] 1.4	[6] 24.6	28.3	60.7	11.0	(3)	Silt loam.
	33-44	IIC3	18.6	23.9	17.8	25.7	3.7	89.7	3.7	6.6	43.5	Coarse sand.
Keith silt loam: S-58-Nebr-25-5(1-7).	0-6	A1p	.1	.2	.1	1.6	28.2	30.2	48.6	21.2	(4)	Loam.
	6-12	B21t	<.1	.1	.1	1.7	25.6	27.5	44.7	27.8	(4)	Clay loam.
	12-16	B22t	<.1	.1	.1	1.7	24.8	26.7	46.5	26.8	(4)	Loam to clay loam.
	16-24	B3	<.1	<.1	<.1	1.8	[5] 25.8	27.6	48.4	24.0	(4)	Loam.
	24-34	Cca	<.1	.1	<.1	[5] 1.5	[5] 28.1	29.7	54.0	16.3	(4)	Silt loam.
	34-41	C2	<.1	.1	[7] .1	[7] 1.4	[7] 30.2	31.8	52.7	15.5	(4)	Silt loam.
	41-60	C3	<.1	<.1	<.1	[7] 1.2	[7] 33.3	34.5	52.0	13.5	(4)	Silt loam.
Keith silt loam: S-58-Nebr-25-6(1-7).	0-6	A1p	.1	.2	.1	2.1	31.9	34.4	46.1	19.5	(4)	Loam.
	6-11	B21t	<.1	.1	.1	1.9	30.8	32.9	44.3	22.8	(4)	Loam.
	11-19	B22t	<.1	.1	.1	1.7	28.5	30.4	44.7	24.9	(4)	Loam.
	19-23	B3	<.1	.1	.1	1.9	29.7	31.8	46.8	21.4	(4)	Loam.
	23-35	Cca	<.1	<.1	<.1	[5] 1.5	[5] 32.7	34.2	51.4	14.4	(4)	Silt loam.
	35-46	C2	<.1	.1	.1	[5] 1.7	[5] 38.6	40.5	45.8	13.7	(4)	Loam.
	46-60	C3	<.1	<.1	<.1	[5] 1.4	[5] 43.9	45.3	43.6	11.1	(4)	Loam.
Goshen silt loam: S-58-Nebr-25-1 (1-7).	0-5	A1p	.2	.6	1.8	7.7	23.0	33.3	47.8	18.9	(4)	Loam.
	5-13	A12	.3	.8	2.2	10.4	23.7	37.4	41.5	21.1	(3)	Loam.
	13-24	B21	.3	.8	2.3	10.0	23.0	36.4	38.8	24.8	(3)	Loam.
	24-30	B22	.1	.4	1.2	6.5	24.3	32.5	42.7	24.8	(3)	Loam.
	30-37	B3	.1	[7] .3	[7] .9	[7] 4.7	[7] 28.7	34.7	47.3	18.0	(3)	Loam.
	37-47	Cca	[7] .3	[7] .7	[7] 1.8	[7] 7.7	[7] 29.1	39.6	44.3	16.1	(3)	Loam.
	47-60	IIC	1.0	2.8	9.5	35.5	23.4	72.2	10.0	17.8	(3)	Fine sandy loam.
Goshen silt loam: S-58-Nebr-25-2 (1-7).	0-7	A1p	.1	.7	1.1	4.4	27.5	33.8	46.7	19.5	(4)	Loam.
	7-14	A12	<.1	.4	.7	3.4	25.1	29.6	44.6	25.8	(4)	Loam.
	14-21	B21	.1	.4	.6	3.0	25.6	29.7	45.4	24.9	(4)	Loam.
	21-30	B22	<.1	.2	.4	2.5	23.5	26.6	47.0	26.4	(4)	Loam.
	30-36	B3	<.1	.2	.3	1.7	23.0	25.2	52.7	22.1	(4)	Silt loam.
	36-47	Cca	<.1	.1	[5] .2	[5] 1.5	[5] 26.2	28.0	56.0	16.0	(4)	Silt loam.
	47-60	C2	.1	.2	[5] .2	[5] 1.9	[5] 34.3	36.7	49.6	13.7	-------	Loam to silt loam.

[1] Particles between 2 millimeters and ¾ inch across.
[2] Data obtained by direct distillation of adsorbed ammonia.
[3] Trace: 0 to 5 percent.
[4] Value determined but below minimum reportable value.

selected soils of Deuel County

Nebraska. Dashes indicate determination was not made]

Chemical analysis															
Reaction (pH)	Organic matter			Electrical conductivity (EC x 10^3) Millimhos. per cm. at 25° C.	$CaCO_3$ equivalent	Cation exchange capacity [2] (NH_4Ac)	Extractable cations (meq./per 100 gm.)					Base saturation (capacity by NH_4Ac)	Exchangeable sodium percentage	Ions in saturation extract (meq./per liter)	
1:1	Organic carbon	Nitrogen	C/N ratio				Ca	Mg	H	Na	K			Na	K
	Percent	*Percent*			*Percent*	*Meq./per 100 gm.*						*Percent*			
6.4	0.88	0.078	11	0.5	--------	11.8	6.4	2.2	3.2	0.2	2.1	--------	2	1.1	1.2
7.2	.50	.053	9	.6	<1	10.3	6.0	2.4	1.6	.7	1.7	--------	6	2.9	.8
7.9	.97	.101	10	1.2	<1	30.7	18.7	9.8	<.1	3.5	4.4	--------	10	7.0	1.1
8.5	.40	.052	8	1.9	4	24.0	------	------	<.1	3.8	4.3	--------	12	12.4	1.6
8.7	.20	--------	------	1.1	11	18.2	------	------	<.1	3.2	3.8	--------	15	7.4	1.1
8.6	.14	--------	------	1.3	8	16.6	------	------	<.1	2.9	3.4	--------	15	8.7	1.3
9.4	.01	--------	------	1.0	<1	3.0	------	------	<.1	.6	.4	--------	13	6.1	.8
6.4	1.19	.116	10.2	.5	--------	13.4	7.0	2.4	4.0	.4	2.7	--------	2	1.5	1.3
7.8	.59	.068	9	.6	<1	9.4	5.1	2.0	.8	1.0	2.0	--------	8	3.8	.9
8.0	.99	.107	9	.9	<1	35.3	16.6	11.3	.4	5.0	6.8	--------	13	6.2	1.0
8.7	.51	.061	8	1.1	5	24.7	------	------	<.1	4.2	5.6	--------	15	8.1	1.4
8.7	.30	.036	8	.9	11	20.0	------	------	<.1	2.7	5.1	--------	12	5.4	1.5
8.6	.16	--------	------	.8	9	18.2	------	------	<.1	1.8	4.9	--------	9	4.1	1.6
9.3	.02	--------	------	.9	1	5.2	------	------	<.1	.9	1.0	--------	15	5.9	1.1
6.5	1.08	.098	11	.4	<1	16.4	12.3	3.2	3.2	.1	1.5	--------	1	.3	.6
7.3	.54	.061	9	.4	<1	21.2	16.3	5.1	2.0	.1	2.3	--------	<1	.3	.7
7.4	.66	.075	9	.4	<1	22.2	17.3	5.8	.8	.1	2.4	--------	<1	.4	.9
7.8	.51	.062	8	.5	<1	21.0	18.2	6.0	<.1	<.1	2.7	--------	<1	.6	1.2
8.2	.31	--------	------	.6	6	17.7	------	------	<.1	.5	3.1	--------	2	1.6	1.5
8.5	.21	--------	------	.7	8	16.4	------	------	<.1	.9	3.3	--------	5	3.2	1.4
8.6	.17	--------	------	.9	6	15.5	------	------	<.1	1.6	3.2	--------	9	5.2	1.2
6.6	1.00	.091	11	.4	<1	16.0	11.4	3.0	2.4	.1	1.8	--------	1	.2	.8
6.8	.64	.068	9	.4	<1	20.2	15.0	3.9	2.9	.1	1.6	--------	<1	.3	.5
7.3	.52	.065	8	.4	<1	21.8	16.8	4.7	1.2	<.1	1.8	--------	<1	.4	.6
7.7	.47	.058	8	.5	1	21.1	23.7	5.0	1.2	<.1	2.0	--------	<1	.4	.8
8.1	.28	.051	5	.5	7	17.4	------	------	<.1	.1	2.5	--------	<1	.5	1.1
8.3	.18	--------	------	.6	6	15.4	------	------	<.1	.5	3.0	--------	2	1.8	1.4
8.5	.13	--------	------	.7	5	13.6	------	------	<.1	1.1	3.0	--------	7	3.7	1.2
6.1	1.48	.123	12	.4	--------	16.6	10.6	2.4	5.2	.1	1.7	89	--------	.2	.9
6.7	.81	.081	10	.4	<1	16.8	12.4	3.3	2.4	<.1	1.2	100	--------	.3	.4
7.2	.57	.061	9	.4	<1	19.4	14.2	4.3	2.4	.1	1.6	104	--------	.5	.5
7.5	.47	--------	------	.4	<1	21.2	15.4	5.5	1.6	.1	2.1	109	--------	.5	.7
8.0	.32	--------	------	.6	4	18.0	------	------	<.1	.1	2.3	--------	--------	.7	1.0
8.2	.22	--------	------	.6	8	15.7	------	------	<.1	.3	2.2	--------	--------	1.8	1.1
8.3	.09	--------	------	.6	6	12.3	------	------	<.1	.3	1.5	--------	--------	1.8	1.0
6.1	1.44	.120	12	.7	--------	16.6	11.2	2.6	4.8	.1	2.5	99	--------	.4	1.7
6.7	.72	.075	10	.4	<1	19.8	15.2	3.8	2.8	<.1	1.7	104	--------	.3	.6
7.0	.65	.069	9	.4	<1	19.6	15.4	4.2	2.0	.1	1.7	109	--------	.3	.5
7.3	.60	.072	8	.4	<1	21.7	16.7	5.2	1.6	.1	2.3	112	--------	.3	.8
8.0	.51	--------	------	.5	3	21.8	------	------	<.1	.1	2.8	--------	--------	.4	1.1
8.1	.30	--------	------	.5	5	19.8	------	------	<.1	.1	3.5	--------	--------	.5	1.5
8.2	.20	--------	------	.6	7	16.7	------	------	<.1	.3	3.4	--------	--------	.5	1.8

[5] 5 to 25 percent is concretions of calcium carbonate.
[6] 5 to 25 percent is concretions of calcium carbonate, and 0 to 5 percent is smooth, black concretions.
[7] 5 to 25 percent is concretions of calcium carbonate, and 0 to 5 percent is smooth, dark-brown to black concretions.

C1—17 to 25 inches, light-gray (10YR 7/2) silt loam, pale brown (10YR 6/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.
C2—25 to 33 inches, light-gray (10YR 7/2) silt loam, pale brown (10YR 6/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous; abrupt, smooth boundary.
IIC3—33 to 44 inches, fine to coarse, well-rounded Pleistocene gravel.

Pebbles are scattered throughout the profile.

Keith silt loam (S–58–Nebr–25–5(1–7)): Located about 225 feet south and 135 feet east of the northwest corner of the SW¼ of sec. 7, T. 14 N., R. 41 W.; approximately 10 miles north of Big Springs, Nebr.

A1p—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.
B21t—6 to 12 inches, brown (10YR 4/3) silt loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.
B22t—12 to 16 inches, brown (10YR 4/3) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, fine and medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.
B3—16 to 24 inches, pale-brown (10YR 6/3) silt loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.
Cca—24 to 34 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.
C2—34 to 41 inches, light-gray (10YR 7/2) silt loam, pale brown (10YR 6/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.
C3—41 to 60 inches, light-gray (10YR 7/2) silt loam, pale brown (10YR 6/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous.

Worm activity is evident throughout the profile and is very prominent in the B3 horizon.

Keith silt loam (S–58–Nebr–25–6(1–7)): Located about 0.15 mile south and 160 feet east of the northwest corner of the SW¼ of sec. 2, T. 14 N., R. 42 W.; approximately 10.5 miles north and 2 miles west of Big Springs, Nebr.

A1p—0 to 6 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure; silghtly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.
B21t—6 to 11 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, blocky structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.
B22t—11 to 19 inches, brown (10YR 5/3) silt loam, dark brown (10YR 3/3) when moist; weak, coarse, prismatic structure breaking to weak, fine and medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.
B3—19 to 23 inches, light brownish-gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; abrupt, wavy boundary.
Cca—23 to 35 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.
C2—35 to 46 inches, light-gray (10YR 7/2) very fine sandy loam, brown (10YR 5/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.
C3—46 to 60 inches, light-gray (10YR 7/2) very fine sandy loam, pale brown (10YR 6/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous.

Evidence of worm activity throughout the profile and of some rodent activity.

Goshen silt loam (S–58–Nebr–25–1(1–7)): Located about 450 feet east and 180 feet north of the southwest corner of sec. 21, T. 14 N., R. 42 W.; approximately 7 miles north and 4 miles west of Big Springs, Nebr.

A1p—0 to 5 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous; abrupt, smooth boundary.
A12—5 to 13 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; clear, smooth boundary.
B21—13 to 24 inches, grayish-brown (10YR 5/2) light silty clay loam, very dark grayish brown (10YR 3/2) when moist; moderate, coarse, prismatic structure breaking to moderate, fine and medium, subangular blocky structure; slightly hard when dry, friable when moist; noncalcareous; clear, smooth boundary.
B22—24 to 30 inches, brown (10YR 5/3) silt loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to weak, fine and medium, subangular blocky structure; soft when dry, very friable when moist; noncalcareous; clear, smooth boundary.
B3—30 to 37 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure breaking to weak, fine and medium, subangular blocky structure; soft when dry, very friable when moist; slightly calcareous; gradual, smooth boundary.
Cca—37 to 47 inches, very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous; abrupt, smooth boundary.
IIC—47 to 60 inches, very pale brown (10YR 7/3) loam, reddish yellow (7.5YR 6/6) when moist; structureless; soft when dry, very friable when moist; highly calcareous; this horizon consists of Tertiary material of the Ogallala formation.

A few medium pebbles are scattered throughout the profile. Worm activity is evident throughout the profile and is very prominent in the B3 horizon.

Goshen silt loam (S–58–Nebr–25–2(1–7)): Located about 0.15 mile north and 130 feet east of the southwest corner of sec. 36, T. 14 N., R. 45 W.; approximately 1.5 miles east and 3 miles north of Chappell, Nebr.

A1p—0 to 7 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium and coarse, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.
A12—7 to 14 inches, grayish-brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure; slightly hard

when dry, very friable when moist; noncalcareous; clear, smooth boundary.

B21—14 to 21 inches, grayish-brown (10YR 5/2) heavy silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, fine and medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; gradual, smooth boundary.

B22—21 to 30 inches, grayish-brown (10YR 5/2) heavy silt loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure breaking to weak, fine and medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; abrupt, smooth boundary.

B3—30 to 36 inches, brown (10YR 5/3) silt loam, dark grayish brown (10YR 4/2) when moist; weak, coarse, prismatic structure breaking to weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; highly calcareous; gradual, smooth boundary.

Cca—36 to 47 inches, light-gray (10YR 7/2) silt loam, pale brown (10YR 6/3) when moist; structureless; soft when dry, very friable when moist; highly calcareous; gradual, smooth boundary.

C2—47 to 60 inches, light-gray (10YR 7/2) silt loam, light brownish gray (10YR 6/2) when moist; structureless; soft when dry, very friable when moist; highly calcareous.

Large worm casts are scattered throughout the profile and are very prominent in the B3 horizon.

Facts About Deuel County

This section will assist newcomers who are not familiar with the county. It discusses physiography, relief, and drainage; climate; agriculture; natural resources; and other general subjects.

Location and Extent

Deuel County is in the southeast corner of the Nebraska panhandle, where it adjoins Colorado. Chappell, the county seat, is in the west-central part and is about 340 miles west of Omaha, about 130 miles east of Cheyenne, Wyoming, and about 180 miles northeast of Denver, Colorado. The county is rectangular. It extends about 30 miles east and west and about 15 miles north and south. It is the smallest county in the Nebraska panhandle and one of the smallest in the State. Its total area is 435 square miles, or 278,400 acres.

Physiography, Relief, and Drainage

Deuel County is in the western part of the Great Plains. It is part of a nearly level to gently undulating Tertiary plain that is mantled in places by silty or slightly sandy loess. The plain is dissected by the deeply entrenched valleys of Lodgepole Creek and the South Platte River. Lodgepole Creek, a perennial stream, enters the county at about the midpoint of the western side, flows southeastward, and leaves the county at about the midpoint of the southern side. The area of tableland south and west of Lodgepole Creek is called South Table. The high plain in the southeast corner has been nearly effaced by the South Platte River. This river flows northeastward across the county (fig. 34). Many small, steep-sided tributaries of the main streams extend into the tablelands. The largest of these tributaries are Sand Draw, O'Neil Draw, Walrath Draw, and Dry Creek.

Figure 34.—**The South Platte River south of Big Springs, Nebraska.**

An integrated stream pattern reaches only about half of the county. Where drainage is not well established on the silty tablelands, runoff water collects in scattered depressions and evaporates or slowly seeps away. Lodgepole Creek drains about 15 percent of the county. A small area in the northeast corner of the county is drained southeastward into Keith County. Runoff from all other land in the county drains into the South Platte River.

Between the tablelands and bottom lands, the rolling and steep breaks are quite gravelly and give rise to shallow soils. Adjacent to the valley of Lodgepole Creek on the eastern side is an area of hummocky sand that, in places, resembles typical Nebraska sandhills. This sandy area is 1 to 2 miles wide; it extends northwestward from the Colorado line for 6 to 7 miles. A smaller area of sand occurs in the northeastern part of the county. A ridge of thick, silty loess begins at a point about 4 miles northwest of Big Springs and extends northwestward to Garden County. This ridge is about 1 mile wide. Another area of thick, silty loess occurs in the extreme northeastern part of the county.

The general slope of the land is toward the southeast, and all drainageways flow in this general direction. Low broken ridges cross the upland in a northwest-southeast direction. The elevation in the county varies from about 3,370 feet at Big Springs to 3,970 feet in the northwestern part of the county. The tablelands are 200 to 300 feet higher than the valley floors. Permanent streams fall about 7 to 10 feet per mile.

Climate[5]

Deuel County is on the High Plains, near the center of North America. The cold winters and hot summers of its continental climate are tempered somewhat by the elevation. Slope is generally southeastward. The elevation ranges from more than 3,900 feet in the northwestern part and slightly over 4,000 feet in the southwest to slightly below 3,400 feet in the southeastern corner along the South Platte River. This slope is a part of the general fall in

[5] By Richard E. Myers, State climatologist, U.S. Weather Bureau.

elevation that begins at the Continental Divide, about 285 miles to the west, and ends at the Missouri River, 320 miles to the east. At this latitude open areas in the Rocky Mountains are comparatively low and permit strong winds from the west to the northwest to reach Deuel County frequently, particularly during winter and spring.

Big Springs is the only station in Deuel County that has weather records. These records are rather short and have several breaks, but the data are similar to those from stations surrounding the county that have long-term records. Climate data in this subsection are given in tables 12, 13, 14, 15, and 16. The data are mostly from Lodgepole, just across the boundary in Cheyenne County.

The soils of Deuel County absorb much of the rainfall, but there is much runoff and water erosion on sloping lands during local downpours. On cultivated land, terracing and stubble-mulch tillage are used to control runoff and reduce water erosion. The hazard of water erosion on the steeper slopes limits the use of these slopes largely to pasture. Because native vegetation is the best protection against erosion, most of the steep slopes are in native grasses.

Strong westerly winds in winter and spring often blow the soils, especially when the soils are dry and their surface is unprotected. A common practice is to leave stubble standing in the field during the winter and spring so that

TABLE 12.—*Temperature and precipitation*

Month	Temperature [1]				Precipitation				
	Average daily maximum	Average daily minimum	Two years in 10 will have at least 4 days with—		Average monthly total [1]	One year in 10 will have—		Days with snow cover of 1 inch or more [3]	Average depth of snow on days with snow cover [3]
			Maximum temperature equal to or higher than—	Minimum temperature equal to or lower than—		Less than [2]—	More than [2]—		
	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Number	Inches
January	41. 7	13. 6	59	−6	0. 32	0. 01	0. 80	8	4. 4
February	45. 0	16. 1	64	−3	. 43	. 06	1. 10	6	2. 7
March	50. 7	22. 0	71	3	1. 03	. 11	1. 93	6	3. 3
April	63. 3	32. 6	80	19	2. 04	. 55	4. 01	1	3. 2
May	72. 5	43. 2	88	31	3. 05	1. 18	5. 40	(4)	2. 5
June	83. 2	52. 7	98	42	3. 09	1. 04	4. 60	0	0
July	92. 2	59. 4	102	52	2. 25	. 85	3. 93	0	0
August	90. 1	57. 6	100	50	2. 08	. 87	4. 24	0	0
September	81. 3	46. 7	96	35	1. 50	. 22	3. 25	(4)	1. 5
October	68. 8	35. 3	84	24	. 84	. 01	1. 91	(4)	3. 0
November	52. 7	22. 6	69	8	. 56	. 01	1. 43	3	3. 3
December	44. 1	16. 9	61	0	. 50	. 06	1. 10	7	2. 9
Year	65. 5	34. 9	[5] 104	[6] −16	17. 69	10. 93	25. 17	32	3. 3

[1] Data from Lodgepole, Cheyenne County, 1931–60.
[2] Data from Lodgepole, 1895–1960.
[3] Data from a number of stations within and surrounding Deuel County, 1931–60.
[4] Less than 1 day.
[5] Average annual highest maximum.
[6] Average annual lowest minimum.

TABLE 13.—*Temperature and precipitation extremes at Lodgepole, Nebr., 1895–1963*

Month	Temperature				Precipitation			
	Highest	Year	Lowest	Year	Driest	Year	Wettest	Year
	°F.		°F.		Inches		Inches	
January	70	1950 [1]	−31	1930	(2)	1961 [1]	1. 61	1921
February	77	1962 [1]	−36	1936 [1]	0	1949	1. 80	1903
March	86	1946 [1]	−23	1960	(2)	1911 [1]	2. 90	1912
April	92	1898	−6	1936	. 04	1948	6. 92	1915
May	98	1934 [1]	10	1907	(2)	1903	6. 63	1949
June	108	1954 [1]	25	1937	(2)	1898	9. 68	1947
July	112	1940	37	1915	. 47	1960	8. 07	1905
August	108	1938	33	1910	(2)	1935	5. 54	1950
September	103	1931	17	1926	0	1953 [1]	5. 98	1942
October	96	1910	0	1917	0	1938 [1]	2. 84	1923
November	84	1897	−22	1896	0	1939 [1]	1. 95	1946
December	76	1939	−33	1919	(2)	1929 [1]	2. 29	1913
Year	112	1940	−36	1936 [1]	10. 00	1910	28. 66	1958

[1] Also in earlier year or years.
[2] Trace.

it protects the soils against wind erosion and also helps conserve moisture by catching or holding the snow. During the summer-fallow season stubble-mulch tillage protects the land against wind and water erosion until a growing crop is well established.

The climate of Deuel County was favorable for an original vegetation of mixed short and mid grasses. Wheat has become the principal cultivated crop. Among the others in the county are sorghum, barley, corn, and hay. Because the annual rainfall of about 18 inches is not enough to produce good crops every year, summer fallowing is extensive.

In winter the weather alternates from mild, when the wind is from the west, to cold, when it is from the north. Wind from the west reaches Deuel County both warm and dry because it moves markedly downslope, and the air is warmed by compression. Winter precipitation is usually light, occurring as snow. Because the snow is usually accompanied by wind, it often drifts badly and part of the ground is not completely covered. Snowfall is often fol-

TABLE 14.—*Probabilities of last freezing temperatures in spring and first in fall*

Probability	Dates for given probability and temperature				
	16° F. or colder	20° F. or colder	24° F. or colder	28° F. or colder	32° F. or colder
Spring:					
1 year in 10 later than	April 16.	April 24.	May 3.	May 15.	May 25.
2 years in 10 later than	April 10.	April 18.	April 27.	May 10.	May 20.
5 years in 10 later than	March 31.	April 8.	April 17.	April 29.	May 9.
Fall:					
1 year in 10 earlier than	October 18.	October 15.	October 7.	September 24.	September 16.
2 years in 10 earlier than	October 24.	October 20.	October 12.	September 30.	September 21.
5 years in 10 earlier than	November 4.	October 30.	October 22.	October 10.	September 30.

TABLE 15.—*Precipitation by month for 10 wettest years at Lodgepole, Nebr., from 1895 through 1963*

Month	1958	1915	1905	1942	1923	1945	1947	1951	1941	1949
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
January	0.05	1.00	0.60	0.18	(1)	0.75	0.33	0.09	0.20	[2] 1.35
February	.70	.65	.30	1.24	.20	.59	.08	.07	.28	.00
March	1.09	1.53	1.45	1.00	1.30	.90	.67	.09	1.45	1.58
April	3.34	6.92	3.62	4.01	2.65	2.52	2.50	2.04	3.15	1.06
May	3.47	6.30	4.70	4.48	6.41	5.31	3.12	1.67	1.79	6.63
June	3.65	3.42	[2] 2.55	3.56	4.37	3.33	9.68	6.48	4.54	5.07
July	7.16	1.86	8.07	1.24	1.38	3.93	2.30	1.72	2.54	2.95
August	4.09	2.03	1.90	1.29	4.50	5.01	.91	2.37	2.76	1.82
September	3.25	2.29	2.45	5.98	.87	2.11	1.94	5.83	2.74	1.24
October	.56	1.56	[2] 1.45	2.26	2.84	.11	.89	1.86	1.93	1.06
November	.29	.20	[2] .20	.64	.51	.26	1.29	.05	.16	(1)
December	1.01	.60	(1)	.72	.45	.35	.48	.93	1.28	.05
Year	28.66	28.36	[2] 27.29	26.60	25.48	25.17	24.19	23.20	22.82	[2] 22.81

[1] Trace.
[2] Partially or wholly interpolated.

TABLE 16.—*Precipitation by month for 10 driest years at Lodgepole, Nebr., from 1895 through 1960*

Month	1919	1899	1898	1903	1911	1934	1931	1939	1895	1940
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
January	[1] 0.15	1.50	0.40	(2)	0.55	0.28	(2)	1.25	0.70	1.10
February	[1] .10	.70	.10	1.80	(2)	.38	.74	.40	.85	.88
March	[1] .60	.80	.10	.52	(2)	.25	1.06	1.30	.20	1.40
April	[1] .55	1.10	.10	.97	1.97	.60	1.56	.54	1.46	1.20
May	2.01	1.25	3.55	(2)	1.31	1.71	.86	2.99	1.61	.96
June	1.72	1.40	(2)	.84	2.03	3.46	3.00	1.96	3.90	1.78
July	1.12	2.65	1.60	2.90	.67	1.53	1.11	.79	1.29	1.61
August	1.41	.55	[1] 1.05	2.80	1.14	2.11	.60	.42	.20	1.10
September	2.04	.00	2.25	.55	.26	.42	1.27	.74	.95	.86
October	(2)	(2)	.10	(2)	2.01	(2)	.40	.78	[1] .15	.69
November	.05	(2)	.70	(2)	.20	.17	.46	.00	.45	(2)
December	.25	.32	.50	.08	.60	.02	.60	.52	[1] .15	.80
Year	[1] 10.00	[1] 10.27	[1] 10.45	10.46	10.74	10.93	11.66	11.69	[1] 11.91	12.38

[1] Partially or wholly interpolated.
[2] Trace.

lowed by mild west winds that are warm enough to melt the snow rather quickly. Many days are favorable for winter grazing because periods of mild weather are frequent and a snow cover is often lacking. Livestock can secure forage from sorghum stubble and the mature grass that has cured in the fields. Sometimes winter wheat grows enough to be pastured, particularly at the beginning and at the end of winter. Care must be taken so that enough cover is left on the ground to prevent wind erosion. Snowfall increases late in winter and reaches a peak in March, but by this time the sun is high enough to melt the snow rapidly after the storm passes, and it does not accumulate from one storm to the next.

As spring advances, precipitation increases to a maximum in June. Rains early in spring are caused by upslope winds and are slow and steady. Snow is rather frequent as late as April and occasionally occurs in May. The snow is wet and sticky in spring and, as a rule, does not drift. Late in spring most of the precipitation occurs as afternoon thundershowers. Frost or freezing temperatures are rather frequent until the middle of May and have occurred early in June. Spring weather is characterized by strong winds and sharp changes in temperature.

Precipitation lessens rapidly in July and August. In summer practically all of the rain comes as thundershowers, which often are violent and often are accompanied by hail. The hailstorms are heaviest and most numerous in June and early in July. Usually the hail falls in local areas, but in most years it damages crops considerably. Hail is particularly hazardous to wheat and barley because these plants head and mature when hailstorms are most frequent. Because the sorghum is younger at this time, it has a better recovery rate if damaged by hail. The frequency and intensity of hailstorms decrease after the middle of July, but the storms that do strike inflict a more lasting damage to the sorghum crop.

The daily range in temperature is wide in summer; afternoons are warm and nights are cool. The cool nights and rather low humidities in the afternoons make summer a pleasant season. A mulch is kept on soils fallowed in summer so that the rise of soil temperature and evaporation are checked. As the nights lengthen late in summer, the temperatures drop even farther and reach the lower forties in August of most years, and generally the thirties or lower during September.

In fall sunshine is abundant. Days are warm, and nights are very cool. The rainfall decreases from about 1.5 inches in September to only 0.5 inch in November. Also, evaporation decreases because days are short, nights are cool, and there is little wind. In most years moisture in summer-fallowed land is sufficient for winter wheat to germinate and to make some growth before winter. Frost or freezing temperatures can be expected by the latter part of September or early in October of most years. By the middle of October occasional outbreaks of cold air from Canada warn of the coming winter, and hard freezing usually occurs by the end of October or early in November. The first cold period is often followed by a considerable amount of fine, mild weather.

In the list that follows are the monthly amounts of potential evapotranspiration, in inches, as computed by the Thornthwaite method from mean temperatures at Lodgepole for the period 1931–60.

March	0.27	August	5.39
April	1.59	September	3.33
May	3.06	October	1.73
June	4.71	November	.30
July	6.20		

December, January, and February are not included, because the mean temperature in those months is below 32° F.

The following are monthly averages of pan evaporation, in inches, that were computed for the period 1942–60 from the data at Kingsley Dam, about 20 miles east of Deuel County.

May	6.73	August	8.95
June	8.31	September	6.67
July	10.08	October	4.09

The direction of prevailing wind is southeast from May through September and northwest from October through April. The annual average speed is about 10 to 11 miles per hour. March, April, and May have the highest averages, approximately 11 to 13 miles per hour. Periods when winds reach 30 to 50 miles per hour are frequent during winter and spring. Occasional damaging winds with gusts as high as 100 miles per hour are associated with severe thunderstorms and squalls in spring and early in summer.

Settlement and Population

The area that is now Deuel County was part of the hunting grounds of the Ogallala and Brule Indians, the two most powerful bands of the Teton Sioux. In 1834 the land in the region was set aside by the U.S. Government for the Indians. The first white settlers arrived in the area in 1850. Until 1861, when the telegraph was built through this region, communication with the outside was by the Pony Express.

The Union Pacific Railroad reached Deuel County in 1868. It followed the trail blazed by the trappers and gold seekers, who passed through on the Oregon Trail. The railroad stimulated settlement in this area, especially in the southern part of the county along Lodgepole Creek and the South Platte River. The army posts that were established to protect the railroad crews from the Indians were partly responsible for the push of settlers into the county.

After crops were grown successfully in the area, homesteaders settled on the tablelands in the north-central part of the county. Some of the first settlers were a group of Swedish immigrants who settled at Froid in 1884. They built a church of sod in 1886, and the church served as a school house for 3 months of the year. But the town of Froid did not last, and the area later became a part of Garden County.

In 1888, Deuel County was organized from part of the large county of Cheyenne. Deuel County lost three-fourths of its original territory in the 1909 election, when Garden County was formed from the northern part.

As late as 1884 Chappell was only a railroad siding with a station house. During that year the town was surveyed and laid out, but few people settled permanently. Chappell was not incorporated until 1907, and even then it was difficult to find the 200 people who were required for incorporation. The town has always been considered the county

seat, but a series of elections and law suits were needed before it was so designated in 1894.

Big Springs, the only other town in the county, got its name from a nearby spring that furnished water for settlers. Although it was settled before Chappell, the town was not surveyed by the Union Pacific Railroad until 3 months after Chappell was laid out. Not until 1917 did Big Springs become a town.

The population of Deuel County, and of Chappell and Big Springs, has been relatively stable since 1920. In 1920 there were 3,282 people in the county, and in 1960, 3,125. The population of Chappell was 1,131 in 1920 and 1,280 in 1960. Big Springs had 408 people in 1920 and 506 in 1960.

Community Facilities and Recreation

Deuel County has 12 rural schools, 2 elementary schools, and 2 high schools. According to the county superintendent of schools, the number of students enrolled in the schools of Deuel County for the year 1959–60 totaled 814.

In 1959–60, 10 of the rural schools had only 1 teacher each, and 2 had 2 teachers. The school system in Chappell consists of one elementary school and the Deuel County High School. This high school serves two-thirds of the county. A new addition to the Deuel County High School was completed in 1958. Big Springs has one elementary school and one high school. The Big Springs Rural High School serves one-third of the county.

The county has 12 churches—8 in Chappell, 3 in Big Springs, and 1 rural. The only hospital is in Chappell. Libraries are located at both Chapell and Big Springs, and each of these communities has two small parks. One park in each town has a public swimming pool. Golf courses are located at Chappell, Big Springs, and north of Julesburg, Colorado. Pheasant hunting in the uplands of the county is good.

Transportation, Power, and Markets

The main line of the Union Pacific Railroad enters the county from the east, follows the South Platte River into Colorado, and reenters the county in the valley of Lodgepole Creek. It then follows the valley westward beyond the county line.

A road runs on almost every section line; farm-to-market roads are graded and graveled. U.S. Highway No. 30 runs from east to west and almost bisects the county. State Route 27 also nearly bisects the county, but its direction is from north to south. U.S. Highway No. 138 parallels the South Platte River, and the Union Pacific Railroad runs across the southeast corner of the county.

Rural electric lines provided with aid from the Rural Electrification Administration extend into almost every part of the county. All farms have electric lights. Electric power is widely used for home freezers, crop driers, and other machines. Electricity powers most irrigation pumps in the county.

Grain and livestock are delivered to Big Springs, Chappell, and Julesburg, Colo., for shipment to the central markets of Denver and Omaha. A few products are handled at Lodgepole, in Cheyenne County, and at Oshkosh and Lewellen, in Garden County. Sugar beets are processed at Ovid, Colo., about 4 miles south of the Deuel County line. Safflower is processed at Sidney, in Cheyenne County.

Agriculture

This subsection discusses the early agriculture of the county and some of the features of agriculture today.

Early history

Large ranches dominated the early history of the region that now includes Deuel County (*21*), but large operations by cattle companies ended in 1887 when the herd law was passed. Incoming settlers began small farms on much of the land that had been in ranches.

The first dryfarming in western Nebraska was demonstrated in Deuel County on an island in the South Platte River near Big Springs. Cattlemen were surprised when good crops were raised.

When Deuel County was organized in 1888, settlers lived on the tablelands. Land sold at $12.50 an acre. At the Chappell Fair the crops displayed were potatoes, wheat, oats, corn, squash, citron, buckwheat, sugarcane, flax, and millet. At this time sorghum mills were busy.

A series of dry years early in 1890's forced many of the farmers to abandon the county. The early farmers did not know how to cope with the adverse climate.

In 1905, homesteads increased in size and farming improved. A combination of stock raising and farming proved most profitable. Chiefly grown were forage crops and, for food, wheat, corn, and vegetables. Living expenses were met by the sale of butter, milk, and eggs.

In 1915, the type of farming was definitely changing. An increased demand for wheat brought about large-scale production.

Steam engines were used to open up large areas of sod to cultivation. About this time summer fallowing began. Wheat became the chief source of income, and today wheat farming on a large scale is the principal type of agriculture.

Type and number of farms

Since 1945, the number of farms of each type has not changed significantly, except that in that year there were 11 poultry farms and in 1959 there were none. There were no dairy farms in 1959. Miscellaneous and unclassified farms amounted to 30 in 1959, and the number of other kinds of farms was as follows:

Cash grain	245
Livestock other than poultry and dairy	78
General farm	14

Since 1930, the number of farms in the county has decreased steadily while the average size of a farm has increased. Between 1930 and 1959, the number of farms decreased from 500 to 366 and the average-sized farm increased from 524 to 783 acres.

Farm tenure

In recent years, rural population has decreased. In 1959, about 78 percent of the operators lived on farms they operated. Most of the farm operators are either full or part owners. In 1940, about 49 percent of the operators were tenants, but by 1959, only about 30 percent of the

farm operators were tenants. About 14,000 acres of school land in Deuel County is owned by the State of Nebraska.

Present agriculture

The agriculture of today consists mainly of the production of cash crops alone or of cash crops and livestock. Wheat is by far the most important crop grown. Each year about 64 percent of the land in the county is either planted to wheat or is summer fallowed to be followed by wheat the next year. Crops of lesser importance are sorghum, barley, corn, alfalfa, safflower, wild hay, oats, and sugar beets. Because of the acreage controls on wheat in the last few years, some farmers have diverted some of their land to other crops, chiefly to grain sorghum, winter barley, safflower, and feed crops. Table 17 gives the acreage of principal crops grown in Deuel County in stated years, as reported in the census of agriculture.

TABLE 17.—*Acres of principal crops in stated years*

Crop	1945	1950	1954	1959
Corn	12,008	3,723	5,211	6,896
Grain sorghum	67	163	6,616	11,257
Forage sorghum	5,512	2,668	4,737	2,981
Small grains:				
Wheat	82,041	79,090	76,316	64,420
Barley	8,125	3,760	9,325	10,445
Oats	1,667	2,731	3,233	1,172
Rye	1,733	99	275	267
Alfalfa hay	1,532	1,588	2,067	1,701
Wild hay	1,615	2,126	1,306	1,446
Sugar beets	799	274	677	481
Safflower	0	0	0	659

Livestock

Raising beef cattle is the most important livestock enterprise. Brood cows are carried on native grassland, and calves are sold in the fall as feeders. Yearlings are often bought in spring, pastured in summer, and sold in fall as feeders. Sheep, hogs, chickens, and dairy cattle are also raised, and there are a few horses. Livestock sales, mostly beef cattle, are held about once a week at Chappell. The number of livestock on farms and ranches in stated years is given in table 18.

Irrigation

Irrigation in the county is most extensive in the valley of the South Platte River (fig. 35), and there is some irrigation in the valley of Lodgepole Creek. In the oldest type of irrigation used in the county, water is obtained through diversion canals. Of greater importance, however, is irrigation that uses water pumped from shallow wells.

Figure 35.—**Irrigated field of beans and corn in the valley of the South Platte River.**

The Conservation Needs estimate of April 9, 1959, reported that about 8,000 acres were irrigated in the valleys. Some irrigation is practiced on 50 to 60 farms in the county. The Water Resource Division, State of Nebraska, reported that on January 1, 1960, there were 129 wells in the county. These wells were the chief source of irrigation water, but diversion canals in the valley of the South Platte River furnished additional water.

In the near future irrigation is not likely to expand in Deuel County. In the valleys most of the acreage suitable for irrigation is irrigated. Whether good irrigation wells can be developed on the uplands is questionable because the amount of water needed for the productive, deep wells is not adequate and drilling the deep wells is costly.

Corn is the most extensively irrigated crop; about five-sixths of its acreage is irrigated. Alfalfa ranks second and is followed by sugar beets. Other irrigated crops of less importance are beans, oats, sorghum, barley, and potatoes.

Natural Resources

This subsection discusses water supply, natural gas, gravel and sand, and other natural resources in the county.

TABLE 18.—*Number of livestock on farms and ranches in stated years*

Type	1930	1940	1945	1950	1954	1959
Cattle and calves	[1] 5,889	[1] 8,502	14,009	12,441	14,296	13,742
Horses and mules	[1] 2,355	[1] 985	708	276	200	212
Hogs and pigs	[1] 6,964	[2] 3,776	3,948	2,951	1,534	2,860
Sheep and lambs	[3] 4,806	[3] 2,233	5,859	1,422	5,357	3,027
Chickens	[1] 45,578	[2] 44,195	62,657	[2] 30,939	[2] 31,941	[2] 23,345

[1] Over 3 months old.
[2] 4 months old and over.
[3] Over 6 months old.

Water supply

In most of Deuel County wells supply enough water for domestic use and for livestock (fig. 36). The water is obtained at depths of 10 to 40 feet in the valleys of Lodgepole Creek and the South Platte River. On the uplands it is 100 to 300 feet or more below the surface. The main water-bearing formation on the uplands is the Ogallala, and alluvial sand and gravel bear most of the water in the bottom lands (*4*). Chappell is supplied by two 40-foot drilled wells, from which electric turbines pump water directly into the city mains. Each well delivers from 400 to 900 gallons per minute, and there is a reserve supply of 300,000 gallons. The city water is not treated. A few small springs occur along the margins of the silty tablelands. High-producing irrigation wells are located in the valley lands, but it is questionable if good irrigation wells can be developed on the uplands.

Natural gas

The Big Springs natural gasfield is one of the largest fields in the Denver-Julesburg Basin, an oil basin of Cretaceous age (*19*). This field covers nearly 10,000 acres and, at the end of 1957, had 23 producing wells. Gas from this field is collected and processed at, and then shipped from, a plant on U.S. Highway No. 30, about 15 miles east of Chappell.

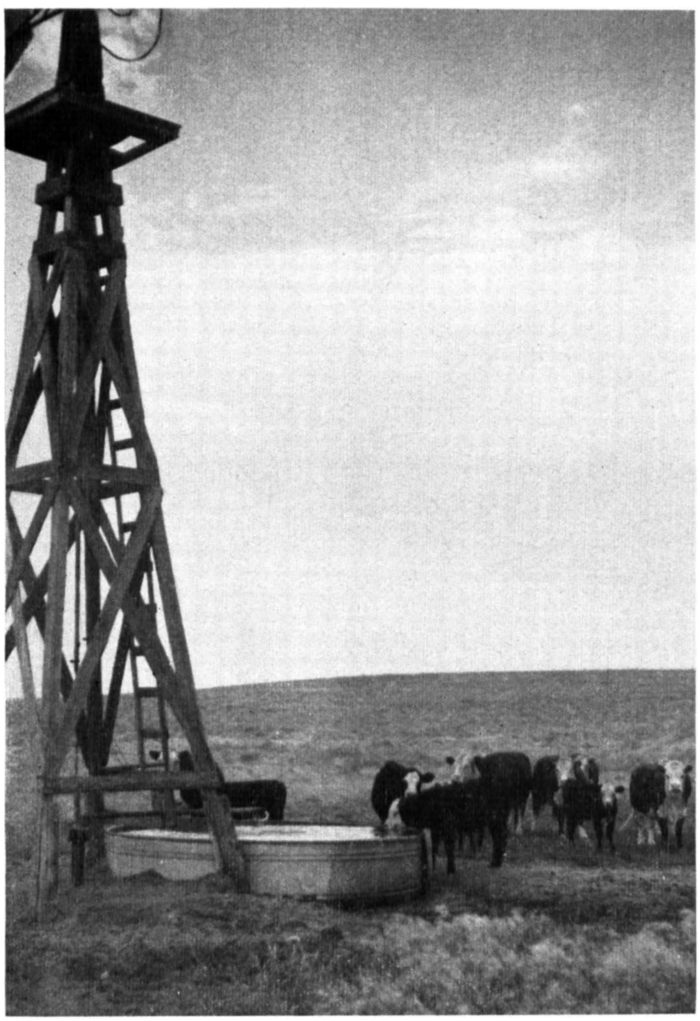

***Figure 36.*—Livestock well in a grassland area southeast of Chappell, Nebraska.**

The natural gas industry is important in the economy of Deuel County. In 1951, production in thousands of cubic feet amounted to 1 million, and in 1953, it reached a peak of nearly 3 million. In 1957, natural gas sold for an average price of 15.6 cents per thousand cubic feet and yielded about $312,000.

Gravel and sand

An abundance of gravel, sand, and other material is available for building roads and other structures. The sources of these materials are sand dunes, sandy and gravelly alluvial lands, and gravelly slopes.

Grassland

The Conservation Needs committee estimated that in 1959 the grassland in the county totaled 61,320 acres and covered 22 percent of the county. This estimate does not include woodland used for pasture in the valley of the South Platte River. Almost all of the grassland is in native grasses. The native grasses are found mainly in steep areas, on shallow soils, or on soils that are extremely sandy or alkaline. None of these areas are well suited to cultivation. The largest areas of grassland are found on the rolling to steep breaks between the silty tablelands and the bench and bottom lands. Another large area is the hummocky sands in the south-central part of the county. Small isolated areas are grazed adjacent to farmsteads and on steep slopes that are near cultivated fields but are too steep to farm. With proper use and management, all of these areas produce good stands of native grasses.

The native vegetation in this county is typical of the grassland of the High Plains. Blue grama, western wheatgrass, and needle-and-thread grow well on medium-textured to slightly sandy soils. Prairie sandreed and sand bluestem are important on the very sandy soils. Where more moisture is available, big bluestem, little bluestem, and switchgrass grow. On the bottom lands that are highly alkaline or saline, inland saltgrass makes up much of the cover. Threadleaf sedge, side-oats grama, little bluestem, and blue grama are important on the shallow gravelly breaks and high knolls.

Formerly cultivated soils that are revegetating are invaded by false buffalograss, red three-awn, and tumblegrass. These undesirable plants also invade pasture that is severely overused.

Woodland

In 1956, Deuel County had 2,100 acres of woodland in which the canopy of trees and brushy plants was 10 percent or more.

Trees grow mainly along the South Platte River and consist mostly of cottonwood and willow. A few trees are found along Lodgepole Creek. Both the bottom lands and tablelands are sparingly dotted with remnants of tree plantings. The trees in these plantings are ash, boxelder, elm, and cottonwood. Except on the bottom lands, these trees are small and scrubby. The trees more recently planted in windbreaks around farmsteads are Chinese elm, American elm, hackberry, ash, boxelder, cottonwood, redcedar, and pine. Small clumps of wild plum and scat-

tered boxelder and of cottonwood and ash trees grow along drainageways in the rough lands. None of the trees in the county are native. Wood products are not of harvestable quality, and most of the woodland areas are used for pasture.

Wildlife

Deer and antelope are the only wild hoofed mammals that remain in Deuel County. Smaller mammals include raccoon, weasel, mink, opossum, badger, coyote, skunk, jack rabbit, and cottontail rabbit.

Some waterfowl and shore birds use Lodgepole Creek and the South Platte River, but the lack of open water limits the number of these birds that stop on their spring and fall migrations. A few quail and other birds that require woody cover are found along the streams and in and around planted windbreaks. The ring-necked pheasant has been introduced and is the most important game bird in the county. It is quite abundant in areas cultivated to grain. Although pheasant are occasionally reduced in number by severe winters, a sufficient number survives to repopulate the area.

Fish are found in Lodgepole Creek and the South Platte River, but game species are few. Technical assistance for planning wildlife conservation is available through the local Soil and Water Conservation District. Information and assistance may also be obtained from the county agricultural agent and the Nebraska Game, Forestation, and Parks Commission.

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Glossary

Aggregate, soil. A mass or cluster of many soil particles held together, such as a granule, clod, block, or prism.

Alkali soil. A soil that has so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exhangeable sodium (15 percent or higher), or both, that the growth of most crop plants is reduced.

Alkaline soil. A soil that is alkaline throughout most or all of the parts occupied by plant roots. Precisely, any soil horizon having a pH greater than 7.0; practically, a soil having a pH greater than 7.3.

Alluvium. Soil materials deposited on land by streams.

Benchland. Nearly level terraces, or shelflike benches, above the present flood plain of a stream. Benchland consists of old alluvium.

Bottom land. Land bordering streams that consists of recent alluvium and may be flooded.

Calcareous soil. A soil containing calcium carbonate, commonly mixed with magnesium carbonate, in such quantity as to effervesce (fizz) visibly when dilute hydrochloric acid is applied. A calcareous soil has an alkaline reaction.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Claypan. A dense soil horizon, containing much clay, that normally is very slowly permeable and is separated more or less abruptly from the overlying soil.

Colluvium (colluvial soil material). Soil material that has moved downhill and has accumulated on the lower parts of slopes and at the foot of hills. Colluvium is moved downhill by the force of gravity and, to some extent, by soil creep, frost action, and local wash.

Color, soil. Soil colors are described in the section "Formation and Classification of Soils" by such terms as grayish brown or reddish brown, used with the corresponding symbols of a Munsell color chart. In this chart, colors are arranged by hue, value, and chroma. *Hue* is the dominant spectral (rainbow) color. *Value* is the relative lightness or darkness of color. *Chroma* is the strength, saturation, or intensity of

color. In technical descriptions of a soil, neither a color name nor symbol is adequate when used alone. Both must be used together to insure a definite understanding of color; for example, dark yellowish brown (10YR 4/4). In this example the 10YR designates the hue, the first 4 the value, and the second 4 the chroma.

Complex, soil. A mapping unit consisting of different kinds of soils that occur in such small individual areas or in such an intricate pattern that they cannot be shown separately on a publishable soil map.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Some of the terms commonly used to describe consistence are—

Loose.—Noncoherent; soil does not hold together in a mass.

Friable.—When moist, soil crushes easily under gentle pressure between thumb and forefinger and can be pressed together in a lump.

Firm.—When moist, soil crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, soil readily deformed by moderate pressure but can be pressed into a lump; forms a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, soil adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, soil moderately resistant to pressure but is difficult to break between thumb and forefinger.

Compact.—A combination of firm consistence and close packing or arrangement of soil particles.

Contour stripcropping. The production of crops in fairly narrow strips planted on the contour and at right angles to the natural direction of slope. In Deuel County, strips in cultivated crops are commonly alternated with strips in fallow.

Contour tillage. Cultivation that follows the contour of the land, generally almost at right angles to the slope.

Cropping system. Growing crops in a planned sequence and in combination with the cultural measures and management practices needed to protect and improve the soil.

Depth, effective soil. The depth of soil material that plant roots can penetrate readily to obtain water and plant nutrients. It is the depth to a layer that differs sufficiently in physical or chemical properties from the overlying material to prevent or seriously retard the growth of roots. The depth classes are: (1) *deep*, more than 36 inches; (2) *moderately deep*, 20 to 26 inches; (3) *shallow*, 10 to 20 inches; and (4) *very shallow*, 0 to 10 inches.

Dryland. All land that is not irrigated.

Eolian. Carried or produced by wind; for example, eolian sand.

Flood plain. Nearly level land along streams that overflow during floods.

Genesis, soil. The mode of origin of the soil. Soil genesis refers particularly to the processes responsible for the development of the solum, or true soil, from the unconsolidated parent material.

Great soil group. A broad group of soils that have internal soil characteristics in common.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes and that differs in one or more ways from adjacent horizons in the same profile. These are the major soil horizons:

A horizon. The mineral horizon at the surface. It contains an accumulation of organic matter, has been leached of soluble minerals and clay, or shows the effects of both.

B horizon. The horizon in which clay minerals or other materials have accumulated, that has developed a characteristic blocky or prismatic structure, or that shows the characteristics of both processes.

C horizon. The unconsolidated material immediately under the true soil. In chemical, physical, and mineral composition it is presumed to be similar to the material from which at least part of the overlying solum has developed.

R horizon. Rock underlying the C horizon, or the B horizon if no C horizon is present.

Inclusion. An area of soil that has been included in the mapping unit of a soil of a different kind because the area was too small to be mapped separately on a map of the scale used.

Leaching. The removal of material in solution by water passing through soil.

Loam. Soil that contains 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Loess. A fine-grained eolian deposit consisting dominantly of silt-sized particles.

Mapping unit, soil. Any soil, miscellaneous land type, soil complex, or undifferentiated soil group shown on the detailed soil map and identified by a symbol.

Miscellaneous land type. A mapping unit for areas of land that have little or no natural soil; or that are too nearly inaccessible for orderly examination; or that occur where, for other reasons, it is not feasible to classify the soil.

Morphology, soil. The makeup of the soil, including the texture, structure, consistence, color, and other physical, chemical, mineralogical, and biological properties of the various horizons that make up the soil profile.

Munsell color notation. See Color, soil.

Natural drainage. Refers to moisture conditions similar to those that existed during the development of the soil, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. The following relative terms are used to express natural drainage: *Very poorly drained, poorly drained, imperfectly* or *somewhat poorly drained, moderately well drained, well drained, somewhat excessively drained,* and *excessively drained.*

Natural fertility. The natural quality that enables a soil to provide the proper compounds, in the proper amounts and in the proper balance, for the growth of plants when light, temperature, and the physical condition of the soil are favorable. Relative terms for expressing natural fertility are *high, medium,* and *low.*

Parent material, soil. The horizon of weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Permeability, soil. The quality of a soil that enables water or air to move through it. Terms used to describe permeability are *slow, moderate,* and *rapid.*

Phase, soil. A subdivision of a soil type, series, or other unit in the soil classification system made because of differences in the soil that affect its management but do not affect its classification in the natural landscape. A soil type, for example, may be divided into phases because of differences in slope, stoniness, thickness, or some other characteristic that affects management.

Pleistocene gravel. Beds of gravel on uplands that were deposited during the Pleistocene epoch and, in some places, are exposed on slopes along streams.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See Horizon, soil.

Reaction, soil. The degree of acidity or alkalinity of a soil expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. In words the degrees of acidity or alkalinity are expressed as follows:

	pH		*pH*
Extremely acid	Below 4.5	Mildly alkaline	7.4 to 7.8
Very strongly acid	4.5 to 5.0	Moderately alkaline	7.9 to 8.4
Strongly acid	5.1 to 5.5	Strongly alkaline	8.5 to 9.0
Medium acid	5.6 to 6.0	Very strongly alkaline	9.1 and higher
Slightly acid	6.1 to 6.5		
Neutral	6.6 to 7.3		

Relief. The elevations or inequalities of a land surface, considered collectively.

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disintegrating solid rock. Residual material is not soil but is commonly the material in which a soil has formed.

Saline soil. A soil that contains soluble salts in amounts that impair growth of crop plants but that does not contain excess exchangeable sodium.

Sand. Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Also, the textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Series, soil. A group of soils developed from a particular type of parent material and having genetic horizons that, except for texture of the surface layer, are similar in differentiating characteristics and in arrangement in the profile.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter).

Slick spot. A small area in a field that is slick when wet because it contains excess exchangeable sodium, or alkali.

Slope. The inclination of the land surface from the horizontal; percentage of slope is the vertical distance, divided by horizontal distance, times 100. Thus, a slope of 10 percent is a drop of 10 feet in 100 feet of horizontal distance. As used in this report, slope classes are as follows:

Percent	*Single slopes*	*Complex slopes*
0 to 1	Nearly level	Nearly level.
1 to 3	Very gently sloping	Very gently undulating.
3 to 5	Gently sloping	Undulating.
5 to 9	Sloping	Rolling.
9 to 15	Moderately steep	Hilly.
15 or more	Steep	Steep.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting upon parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Stubble mulch. Stubble or other crop residue left on the soil, or partly worked into the soil, to provide protection from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. In many soils, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer lying beneath the solum, or true soil; the C or R horizon.

Summer fallow. The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting of winter grains.

Surface runoff. The amount of water removed by flow over the surface of the soil. The amount and rapidity of runoff is closely related to slope and is also affected by texture, structure, and porosity of the surface soil; the plant cover; and the prevailing climate. Relative degrees of runoff are *ponded*, *very slow*, *slow*, *medium*, *rapid*, and *very rapid*.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, usually about 5 to 8 inches thick. The plow layer.

Tertiary sandstone. Sandstone formed from highly calcareous sediments deposited on the plains during the Tertiary geologic period. In Deuel County, this sandstone is of the Ogallala formation.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. (See also Clay, Sand, and Silt.) The basic textural classes, in order of increasing proportion of fine particles, are *sand*, *loamy sand*, *sandy loam*, *loam*, *silt loam*, *silt*, *sandy clay loam*, *clay loam*, *silty clay loam*, *sandy clay*, *silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Thickness. As used in this report, generally refers to individual soil horizons. The classes are:

	Inches
Thin	0 to 6
Moderately thick	6 to 12
Thick	12 or more

Tilth, soil. The condition of the soil in relation to the growth of plants, especially soil structure. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable, granular structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Type, soil. A subdivision of the soil series that is made on the basis of differences in the texture of the surface layer.

Undifferentiated soil group. Two or more soils or land types that are mapped as one unit because their differences are not significant to the purpose of the survey or to soil management.

Wind stripcropping. Growing crops in strips that run crosswise to the general direction of prevailing wind and without strict adherence to the contour of the land.

Winnowed. Sifted and sorted by wind. Strong winds remove clay, fine silt, and organic material from the soil and leave the coarser particles; consequently, the soil becomes sandier and more easily eroded.

Woodland site. A group of soils that produce about the same kind and amount of woodland products and that need similar management.

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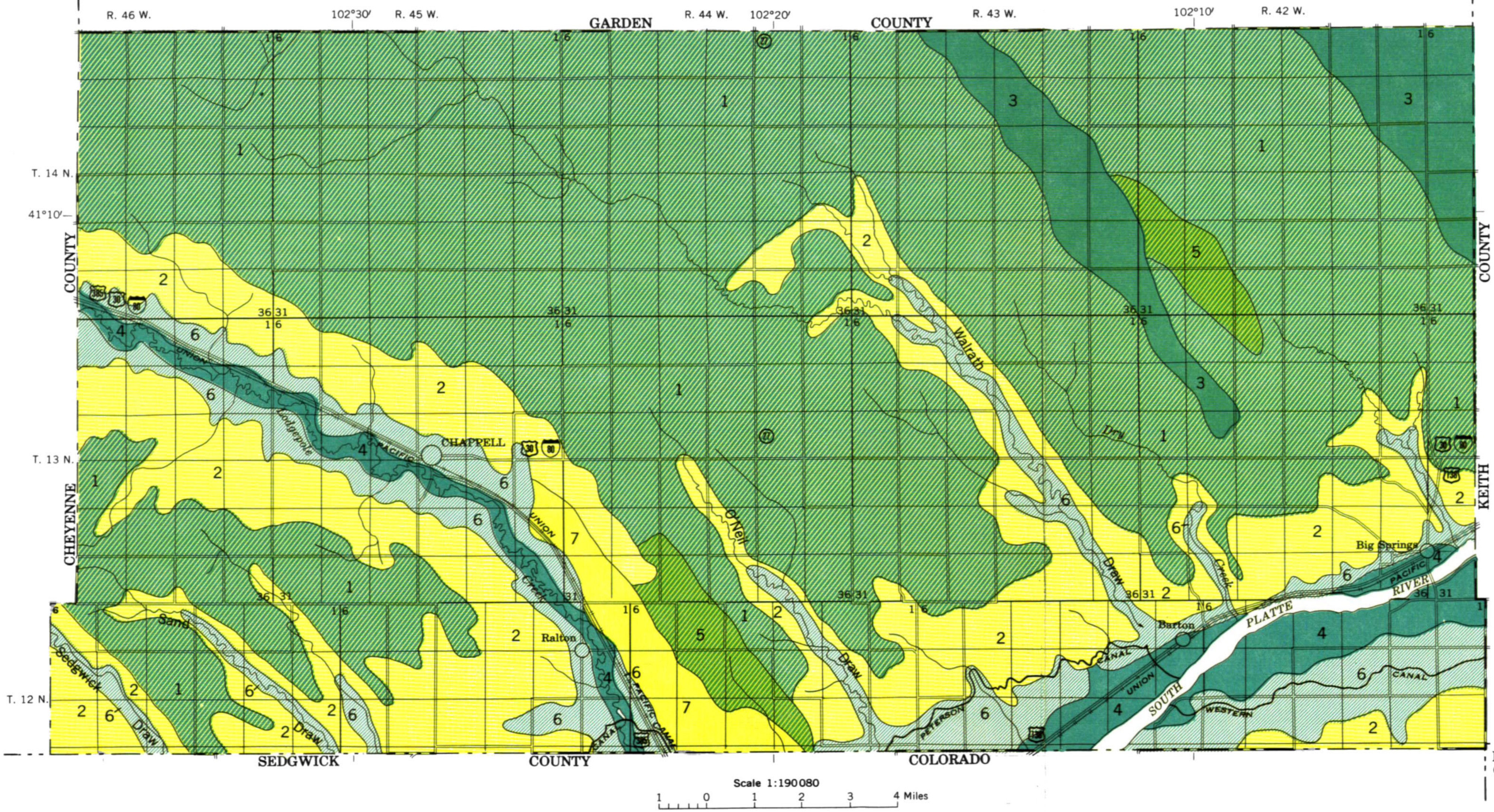
GENERAL SOIL MAP
DEUEL COUNTY, NEBRASKA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

UNIVERSITY OF NEBRASKA
CONSERVATION AND SURVEY DIVISION



SOIL ASSOCIATIONS

1 Keith-Rosebud association: Silty tablelands

2 Dix-Altvan association: Shallow, gravelly breaks

3 Keith-Colby association: Rolling silty uplands

4 Las-Las Animas association: Bottom lands

5 Anselmo-Keith association: Moderately sandy uplands

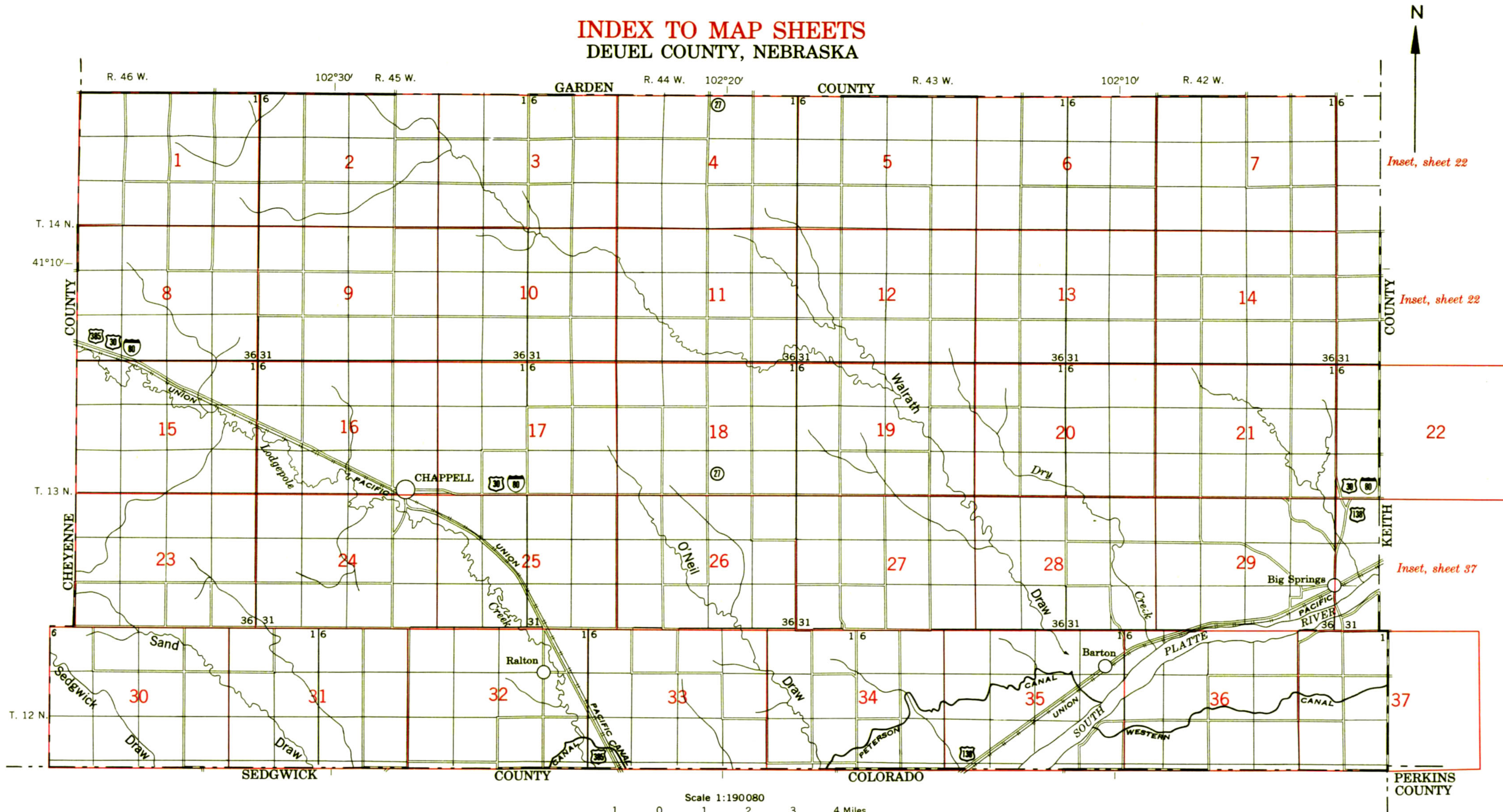
6 Cheyenne-Tripp association: Benchlands

7 Valentine association: Rolling sands

March 1964

INDEX TO MAP SHEETS

DEUEL COUNTY, NEBRASKA



SOIL LEGEND

Each symbol consists of letters, or of letters and numbers; for example ACC, 3AB, or 3AB2. If slope forms part of the soil name, the last capital letter, A, B, C, D, or E in a symbol shows the slope class. A final number, 2, in a symbol shows that the soil is eroded. A final capital letter, W, indicates evidence of erosion that has not modified the soil enough to be estimated with reliability.

SYMBOL	NAME
3AB	Altvan loam, 3 to 5 percent slopes
3AB2	Altvan loam, 3 to 5 percent slopes, eroded
ACC	Altvan-Chappell complex, 5 to 9 percent slopes
ACC2	Altvan-Chappell complex, 5 to 9 percent slopes, eroded
An	Anselmo fine sandy loam, 0 to 1 percent slopes
AnB	Anselmo fine sandy loam, 1 to 5 percent slopes
AnC	Anselmo fine sandy loam, 5 to 9 percent slopes
AoBW	Anselmo loamy fine sand, 0 to 5 percent slopes
AoCW	Anselmo loamy fine sand, 5 to 9 percent slopes
Bf	Bayard fine sandy loam, 0 to 1 percent slopes
BH	Bridgeport and Havre loams, 0 to 1 percent slopes
BHA	Bridgeport and Havre loams, 1 to 3 percent slopes
Bw	Bayard loam, 0 to 1 percent slopes
CD	Canyon complex
ChA	Chappell sandy loam, 0 to 3 percent slopes
CUB	Colby-Ulysses silt loams, 3 to 5 percent slopes
CUD	Colby-Ulysses silt loams, 5 to 15 percent slopes
Cy	Cheyenne loam, 0 to 1 percent slopes
CyA	Cheyenne loam, 1 to 3 percent slopes
DCD	Dix-Chappell loams, 9 to 15 percent slopes
DK	Dawes-Keith loams, 0 to 1 percent slopes
DKA	Dawes-Keith loams, 1 to 3 percent slopes
Du	Dunday loamy fine sand
DxD	Dix complex, 5 to 20 percent slopes
DxE	Dix complex, 20 to 30 percent slopes
Gf	Goshen fine sandy loam, 0 to 3 percent slopes
Gh	Goshen silt loam, 0 to 1 percent slopes
GhA	Goshen silt loam, 1 to 3 percent slopes
KeB	Keith silt loam, 3 to 5 percent slopes
KeB2	Keith silt loam, 3 to 5 percent slopes, eroded
KeC	Keith silt loam, 5 to 9 percent slopes
KeC2	Keith silt loam, 5 to 9 percent slopes, eroded
KK	Keith-Kuma silt loams, 0 to 1 percent slopes
KR	Keith-Richfield silt loams, 0 to 1 percent slopes
KRA	Keith-Richfield silt loams, 1 to 3 percent slopes
KT	Keith and Tripp fine sandy loams, 0 to 3 percent slopes
KTB	Keith and Tripp fine sandy loams, 3 to 5 percent slopes
KTB2	Keith and Tripp fine sandy loams, 3 to 5 percent slopes, eroded
KTC2	Keith and Tripp fine sandy loams, 5 to 9 percent slopes, eroded
Lc	Las Animas fine sandy loam
LS	Laurel soils
Lt	Las loam
Lw	Las Animas loamy sand
Na	Nunn silt loam
NS	Nunn-Slickspots complex
RbA	Rosebud loam, 0 to 3 percent slopes
RbB	Rosebud loam, 3 to 5 percent slopes
RbB2	Rosebud loam, 3 to 5 percent slopes, eroded
RCC	Rosebud-Canyon complex, 5 to 9 percent slopes
RCC2	Rosebud-Canyon complex, 5 to 9 percent slopes, eroded
RCD	Rosebud-Canyon complex, 9 to 15 percent slopes
RdB	Rosebud fine sandy loam, 3 to 5 percent slopes
RdB2	Rosebud fine sandy loam, 3 to 5 percent slopes, eroded
RdC	Rosebud fine sandy loam, 5 to 9 percent slopes
RdC2	Rosebud fine sandy loam, 5 to 9 percent slopes, eroded
Sc	Scott silty clay loam
Ss	Slickspots
Sx	Sandy alluvial land
TK	Tripp-Keith silt loams, 0 to 1 percent slopes
TKA	Tripp-Keith silt loams, 1 to 3 percent slopes
VaC	Valentine fine sand, rolling
VaD	Valentine fine sand, hilly
Wm	Wann loam
Wx	Wet alluvial land

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries

Mine dump

Pits, gravel or other

Power lines

Pipe lines

Cemeteries

Dams

Levees

Tanks

Oil wells

BOUNDARIES

- National or state
- County
- Township, U. S.
- Section line, corner
- Reservation
- Land grant

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches — CANAL, DITCH

Lakes and ponds
- Perennial
- Intermittent

Wells — flowing

Springs

Marsh

Wet spot

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Depressions — Large, Small

SOIL SURVEY DATA

- Soil boundary and symbol — Dx
- Gravel
- Stones
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully

Soil map constructed 1964 by Cartographic Division, Soil Conservation Service, USDA, from 1954 aerial photographs. Controlled mosaic based on Nebraska plane coordinate system, south zone, Lambert conformal conic projection. 1927 North American datum.

GUIDE TO MAPPING UNITS, CAPABILITY UNITS, AND RANGE SITES

[Table 5, p. 27 , gives woodland sites and their soils. See table 3, p. 19 , for predicted yields of dryland crops and table 4, p. 21 , for predicted yields of irrigated crops. Table 9, p. 48 , gives the acreage and proportionate extent of the soils. The acreage and proportionate extent of capability units is given in table 1, p. 11 , for dryland and in table 2, p. 16 , for irrigated land. Absence of irrigated capability unit indicates soil is not suited to irrigation]

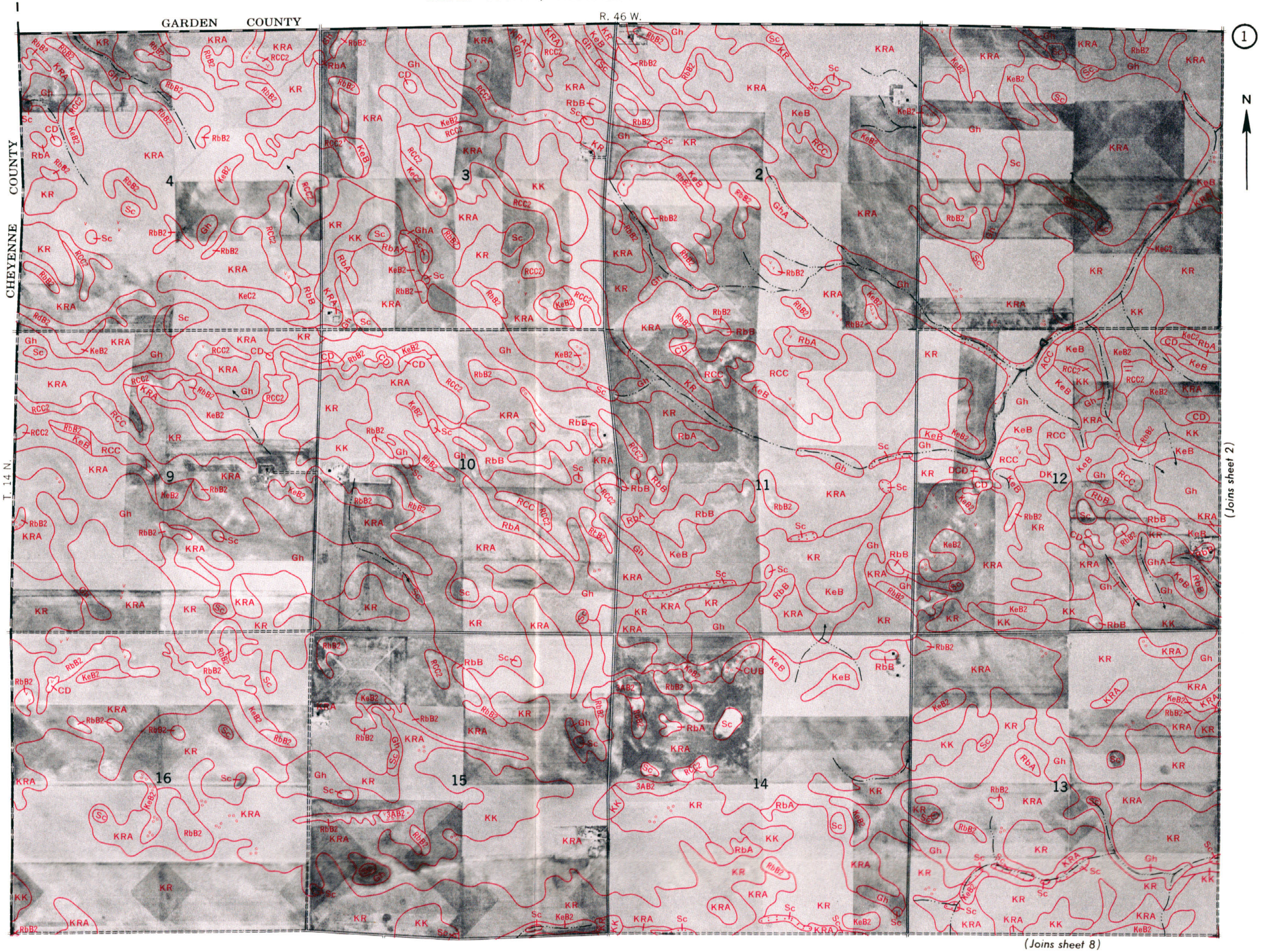
Map symbol	Mapping unit	Page	Capability units: Dryland Symbol	Dryland Page	Irrigated Symbol	Irrigated Page	Range site Name	Range site Page
3AB	Altvan loam, 3 to 5 percent slopes--	49	IVe-1	13	------	--	Silty	23
3AB2	Altvan loam, 3 to 5 percent slopes, eroded--------------------------	49	IVe-1	13	------	--	Silty	23
ACC	Altvan-Chappell complex, 5 to 9 percent slopes------------------	49	IVe-1	13	------	--	Silty	23
ACC2	Altvan-Chappell complex, 5 to 9 percent slopes, eroded----------	49	IVe-1	13	------	--	Silty	23
An	Anselmo fine sandy loam, 0 to 1 percent slopes------------------	50	IIe-3	12	------	--	Sandy	22
AnB	Anselmo fine sandy loam, 1 to 5 percent slopes------------------	50	IIIe-3	12	------	--	Sandy	22
AnC	Anselmo fine sandy loam, 5 to 9 percent slopes------------------	50	IVe-3	13	------	--	Sandy	22
AoBW	Anselmo loamy fine sand, 0 to 5 percent slopes------------------	50	IVe-5	14	------	--	Sandy	22
AoCW	Anselmo loamy fine sand, 5 to 9 percent slopes------------------	50	VIe-5	15	------	--	Sands	22
Bf	Bayard fine sandy loam, 0 to 1 percent slopes------------------	51	IIe-3	12	IIe-3	17	Sandy	22
BH	Bridgeport and Havre loams, 0 to 1 percent slopes------------------	52	IIc-1	11	I-1	16	Silty	23
BHA	Bridgeport and Havre loams, 1 to 3 percent slopes------------------	52	IIe-1	12	IIe-1	16	Silty	23
Bw	Bayard loam, 0 to 1 percent slopes-	51	IIc-1	11	I-1	16	Silty	23
CD	Canyon complex--------------------	52	VIs-4	15	------	--	Shallow Limy	24
ChA	Chappell sandy loam, 0 to 3 percent slopes-------------------------	53	IVe-3	13	IIIe-3	17	Sandy	22
CUB	Colby-Ulysses silt loams, 3 to 5 percent slopes------------------	54	IVe-9	14	------	--	Thin Silty	23
CUD	Colby-Ulysses silt loams, 5 to 15 percent slopes------------------	55	VIe-9	15	------	--	Thin Silty	23
Cy	Cheyenne loam, 0 to 1 percent slopes-------------------------	54	IIIs-5	13	IIs-5	17	Silty	23
CyA	Cheyenne loam, 1 to 3 percent slopes-------------------------	54	IIIe-1	12	IIe-1	16	Silty	23
DCD	Dix-Chappell loams, 9 to 15 percent slopes-------------------------	57	VIs-41	15	------	--	Shallow to Gravel.	23
DK	Dawes-Keith loams, 0 to 1 percent slopes-------------------------	56	IIIs-2	13	------	--	Silty	23
DKA	Dawes-Keith loams, 1 to 3 percent slopes-------------------------	56	IIIe-2	12	------	--	Silty	23
Du	Dunday loamy fine sand------------	57	IVe-5	14	------	--	Sandy	22
DxD	Dix complex, 5 to 20 percent slopes-------------------------	56	VIs-41	15	------	--	Shallow to Gravel.	23
DxE	Dix complex, 20 to 30 percent slopes-------------------------	56	VIIs-3	15	------	--	Very Shallow Porous.	24
Gf	Goshen fine sandy loam, 0 to 3 percent slopes------------------	58	IIe-3	12	------	--	Overflow	22
Gh	Goshen silt loam, 0 to 1 percent slopes-------------------------	58	IIc-1	11	------	--	Overflow	22
GhA	Goshen silt loam, 1 to 3 percent slopes-------------------------	58	IIe-1	12	------	--	Overflow	22
KeB	Keith silt loam, 3 to 5 percent slopes-------------------------	59	IIIe-1	12	------	--	Silty	23
KeB2	Keith silt loam, 3 to 5 percent slopes, eroded------------------	59	IIIe-1	12	------	--	Silty	23
KeC	Keith silt loam, 5 to 9 percent slopes-	59	IVe-1	13	------	--	Silty	23
KeC2	Keith silt loam, 5 to 9 percent slopes, eroded----------------------	59	IVe-1	13	------	--	Silty	23
KK	Keith-Kuma silt loams, 0 to 1 percent slopes----------------------	60	IIc-1	11	------	--	Silty	23
KR	Keith-Richfield silt loams, 0 to 1 percent slopes----------------------	60	IIc-1	11	------	--	Silty	23
KRA	Keith-Richfield silt loams, 1 to 3 percent slopes----------------------	60	IIe-1	12	------	--	Silty	23
KT	Keith and Tripp fine sandy loams, 0 to 3 percent slopes---------------	60	IIe-3	12	------	--	Sandy	22
KTB	Keith and Tripp fine sandy loams, 3 to 5 percent slopes---------------	60	IIIe-3	12	------	--	Sandy	22
KTB2	Keith and Tripp fine sandy loams, 3 to 5 percent slopes, eroded--------	60	IIIe-3	12	------	--	Sandy	22
KTC2	Keith and Tripp fine sandy loams, 5 to 9 percent slopes, eroded--------	61	IVe-3	13	------	--	Sandy	22
Lc	Las Animas fine sandy loam------------	62	IVw-5	14	IIIw-6	17	Subirrigated	22
LS	Laurel soils-------------------------	63	VIs-1	15	VIs-1	18	Saline Sub-irrigated.	22
Lt	Las loam-----------------------------	61	IIw-4	12	IIw-4	17	Subirrigated	22
Lw	Las Animas loamy sand----------------	62	IVw-5	14	IVw-5	18	Subirrigated	22
Na	Nunn silt loam-----------------------	63	IIc-1	11	I-1	16	Silty	23
NS	Nunn-Slickspots complex--------------	63	IVs-1	14	IIIs-1	17	Silty	23
RbA	Rosebud loam, 0 to 3 percent slopes----	65	IIIe-1	12	------	--	Silty	23
RbB	Rosebud loam, 3 to 5 percent slopes----	65	IVe-1	13	------	--	Silty	23
RbB2	Rosebud loam, 3 to 5 percent slopes, eroded----------------------------	65	IVe-1	13	------	--	Silty	23
RCC	Rosebud-Canyon complex, 5 to 9 percent slopes----------------------	65	IVe-1	13	------	--	Silty	23
RCC2	Rosebud-Canyon complex, 5 to 9 percent slopes, eroded--------------	65	IVe-1	13	------	--	Silty	23
RCD	Rosebud-Canyon complex, 9 to 15 percent slopes----------------------	65	VIe-1	15	------	--	Shallow Limy	24
RdB	Rosebud fine sandy loam, 3 to 5 percent slopes----------------------	64	IIIe-3	12	------	--	Sandy	22
RdB2	Rosebud fine sandy loam, 3 to 5 percent slopes, eroded--------------	64	IIIe-3	12	------	--	Sandy	22
RdC	Rosebud fine sandy loam, 5 to 9 percent slopes----------------------	64	IVe-3	13	------	--	Sandy	22
RdC2	Rosebud fine sandy loam, 5 to 9 percent slopes, eroded--------------	64	IVe-3	13	------	--	Sandy	22
Sc	Scott silty clay loam----------------	66	IIIw-2	13	------	--	Overflow	22
Ss	Slickspots---------------------------	66	VIs-1	15	IVs-1	18	Saline Sub-irrigated.	22
Sx	Sandy alluvial land------------------	65	VIs-41	15	------	--	Shallow to Gravel.	23
TK	Tripp-Keith silt loams, 0 to 1 percent slopes----------------------	67	IIc-1	11	I-1	16	Silty	23
TKA	Tripp-Keith silt loams, 1 to 3 percent slopes----------------------	67	IIe-1	12	IIe-1	16	Silty	23
VaC	Valentine fine sand, rolling----------	68	VIe-5	15	------	--	Sands	22
VaD	Valentine fine sand, hilly------------	68	VIIe-5	15	------	--	Choppy Sands	23
Wm	Wann loam----------------------------	69	IIw-4	12	IIw-4	17	Subirrigated	22
Wx	Wet alluvial land--------------------	69	VIIs-3	15	------	--	Very Shallow Porous.	24

730 - 992 O - 65 (Face p. 96)

DEUEL COUNTY, NEBRASKA — SHEET NUMBER 1

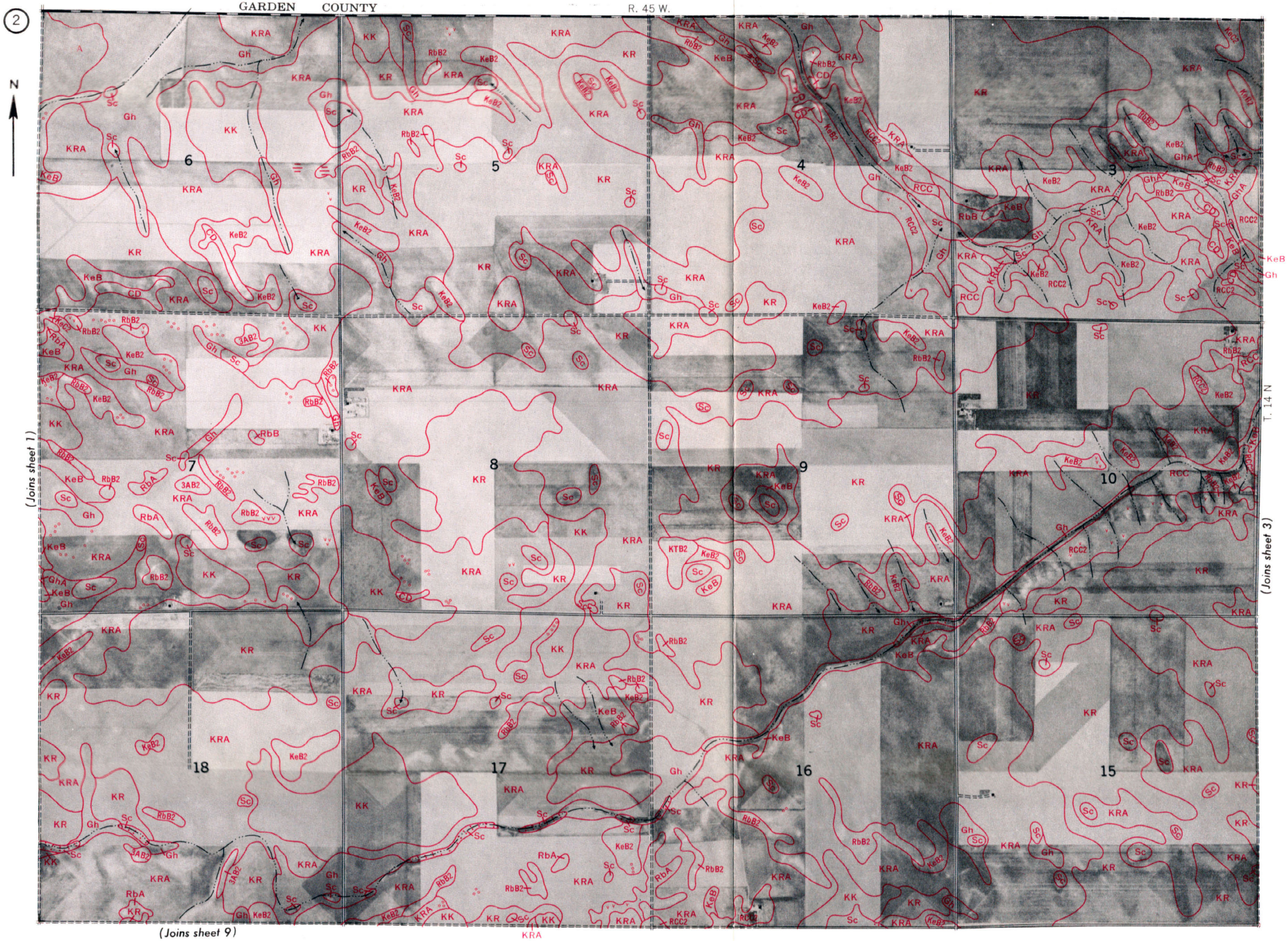
This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division.

Range, township, and section corners shown on this map are indefinite.

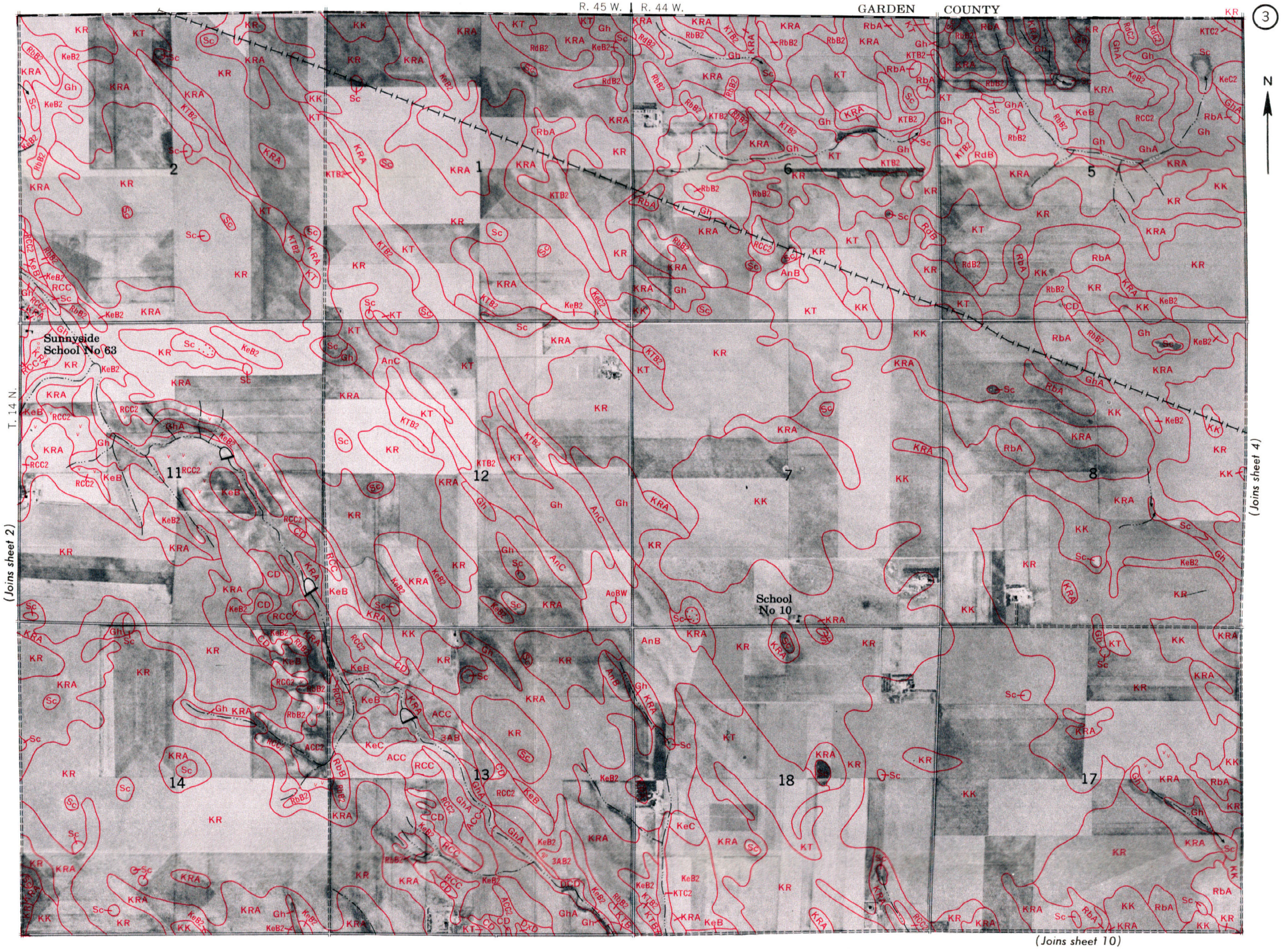


0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

DEUEL COUNTY, NEBRASKA — SHEET NUMBER 2



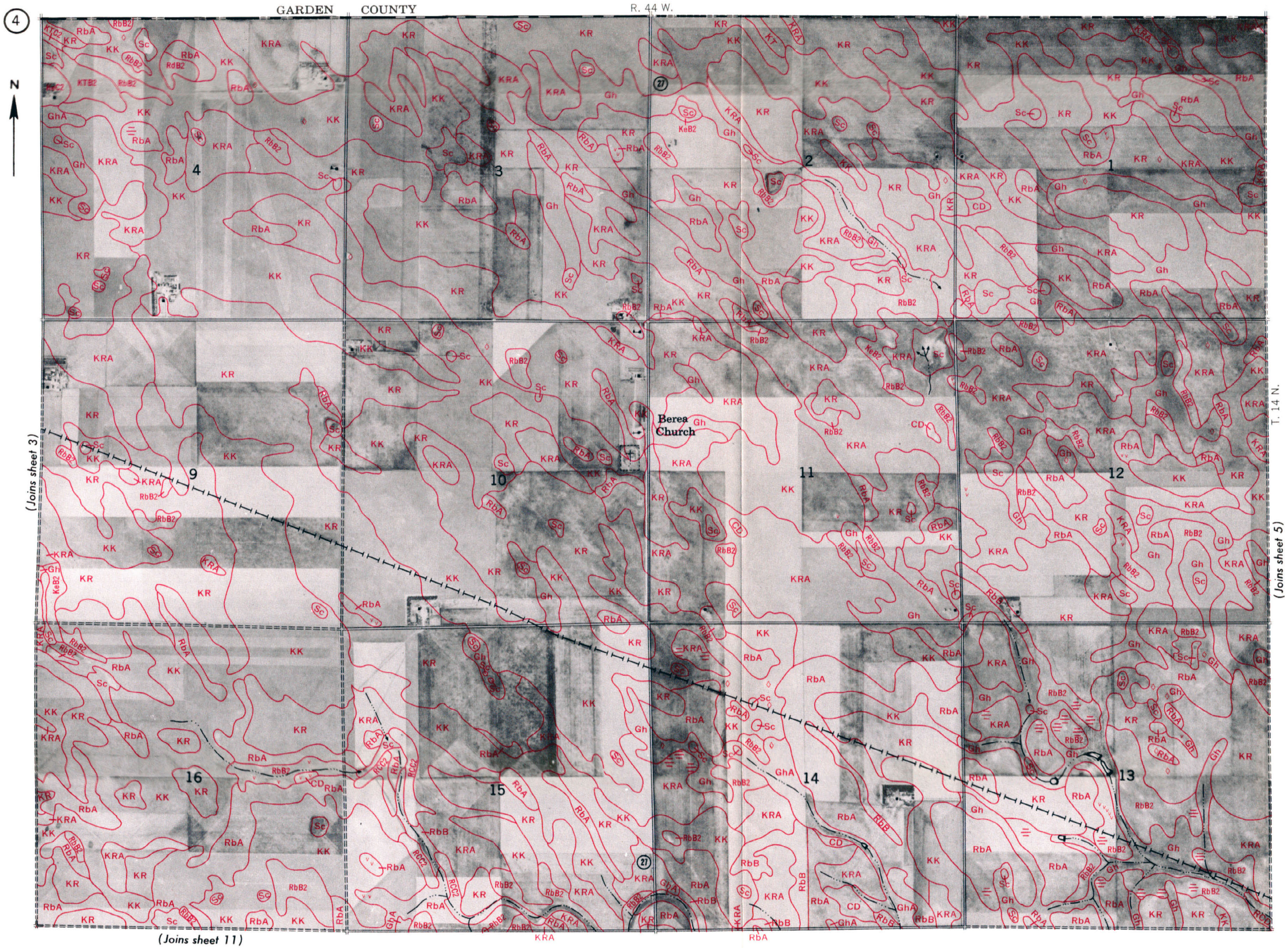
0 ½ 1 Mile Scale 1:20000 0 5000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division.

Range, township, and section corners shown on this map are indefinite.



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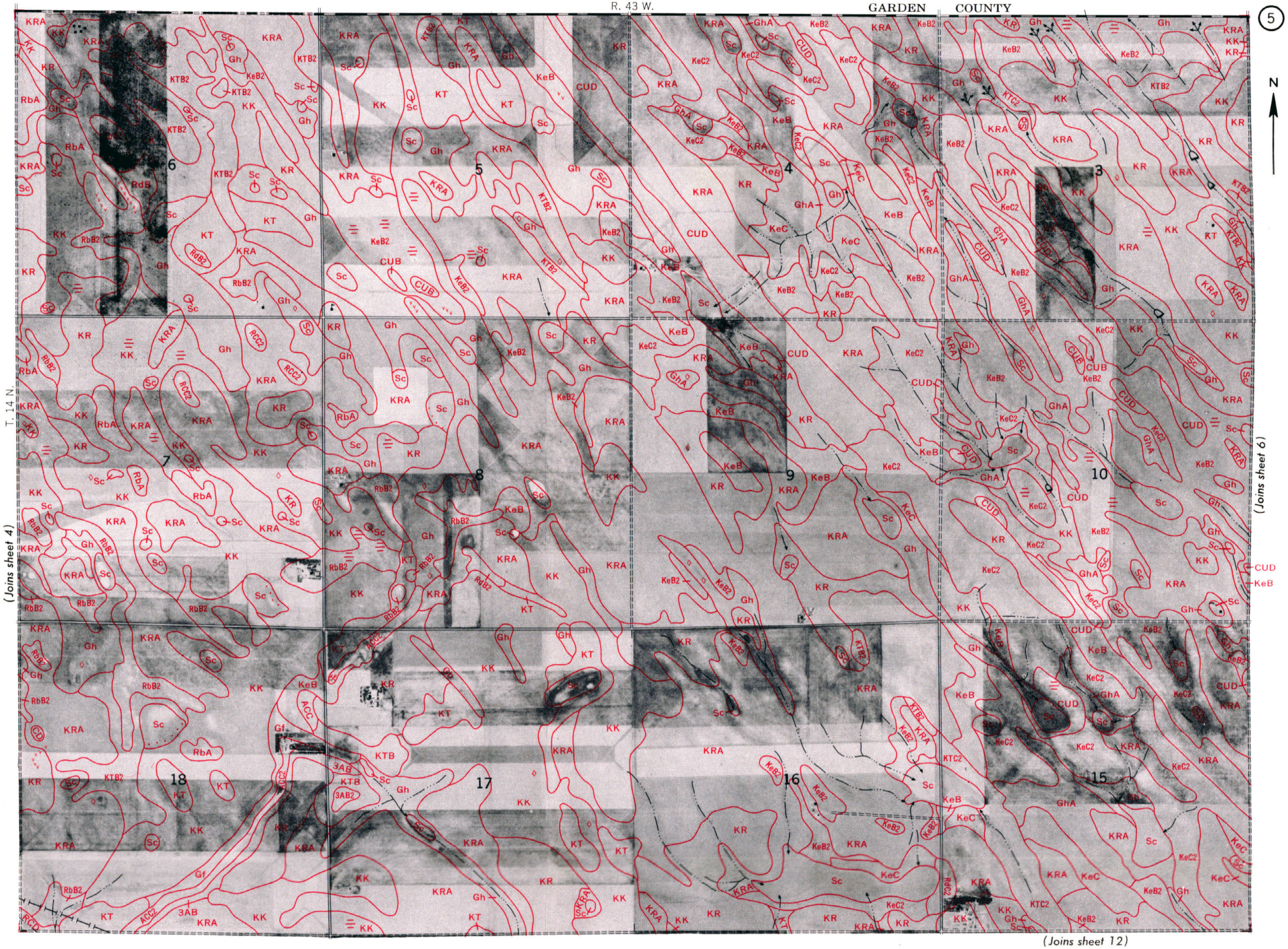
DEUEL COUNTY, NEBRASKA — SHEET NUMBER 5



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division.

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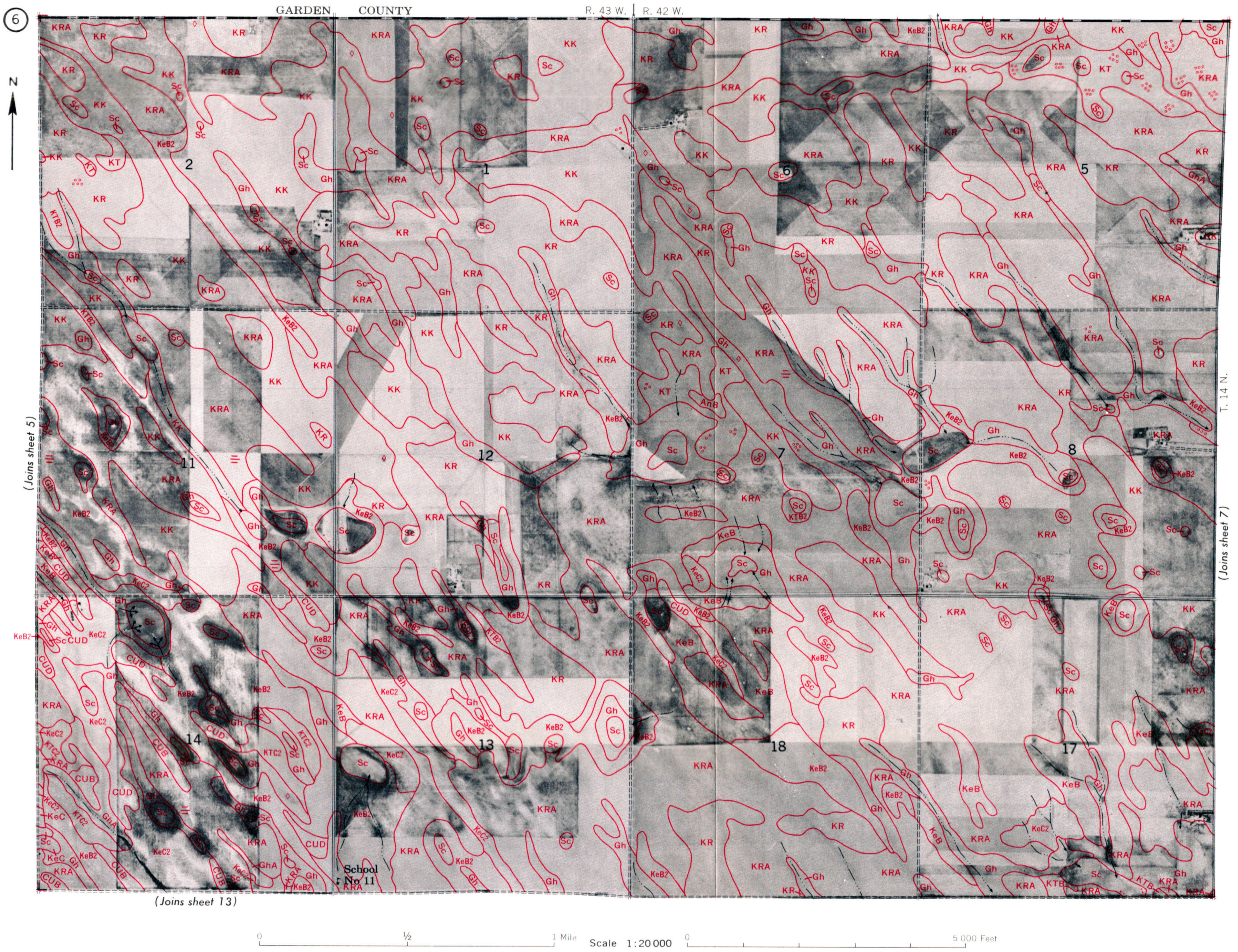
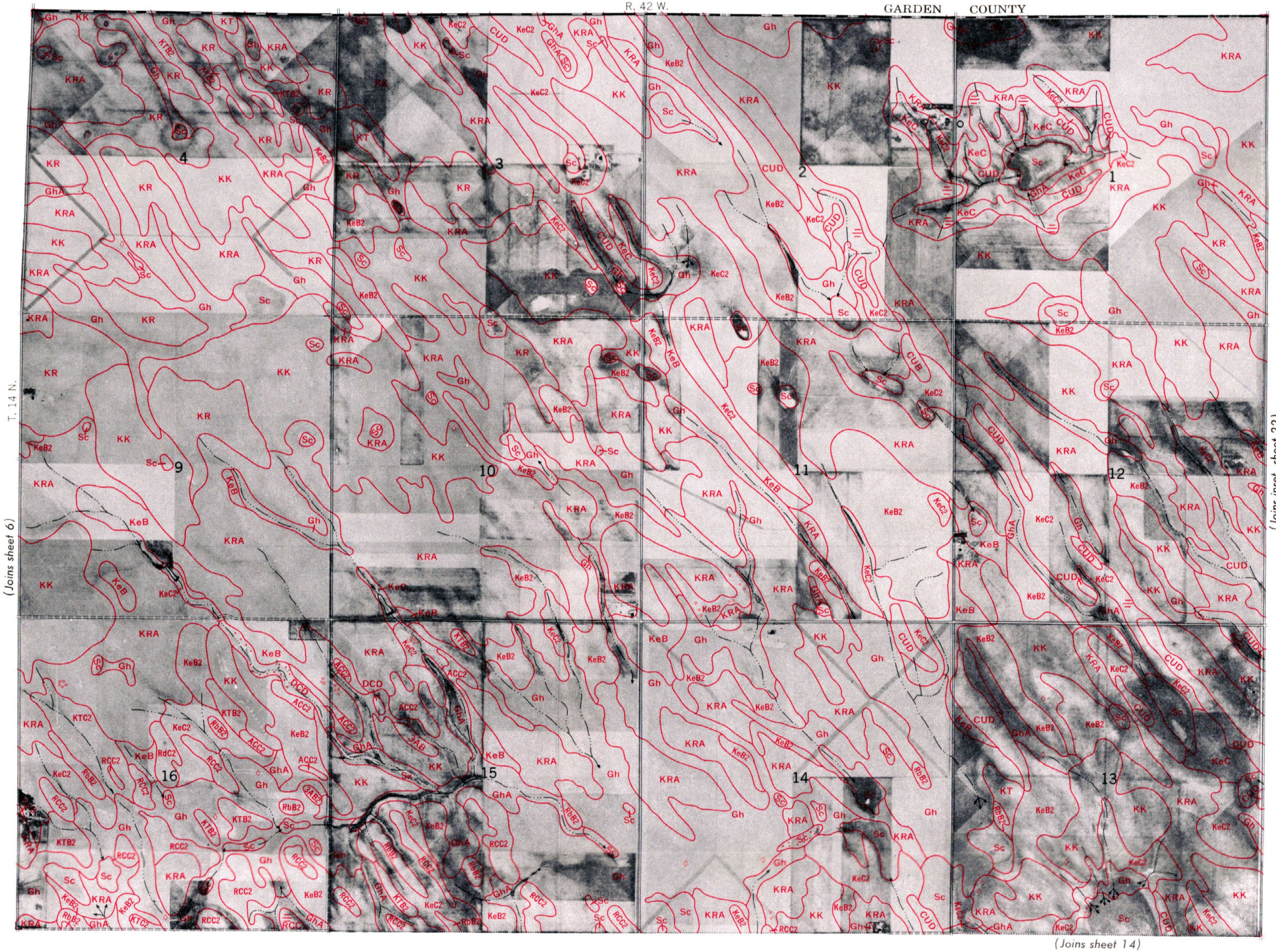
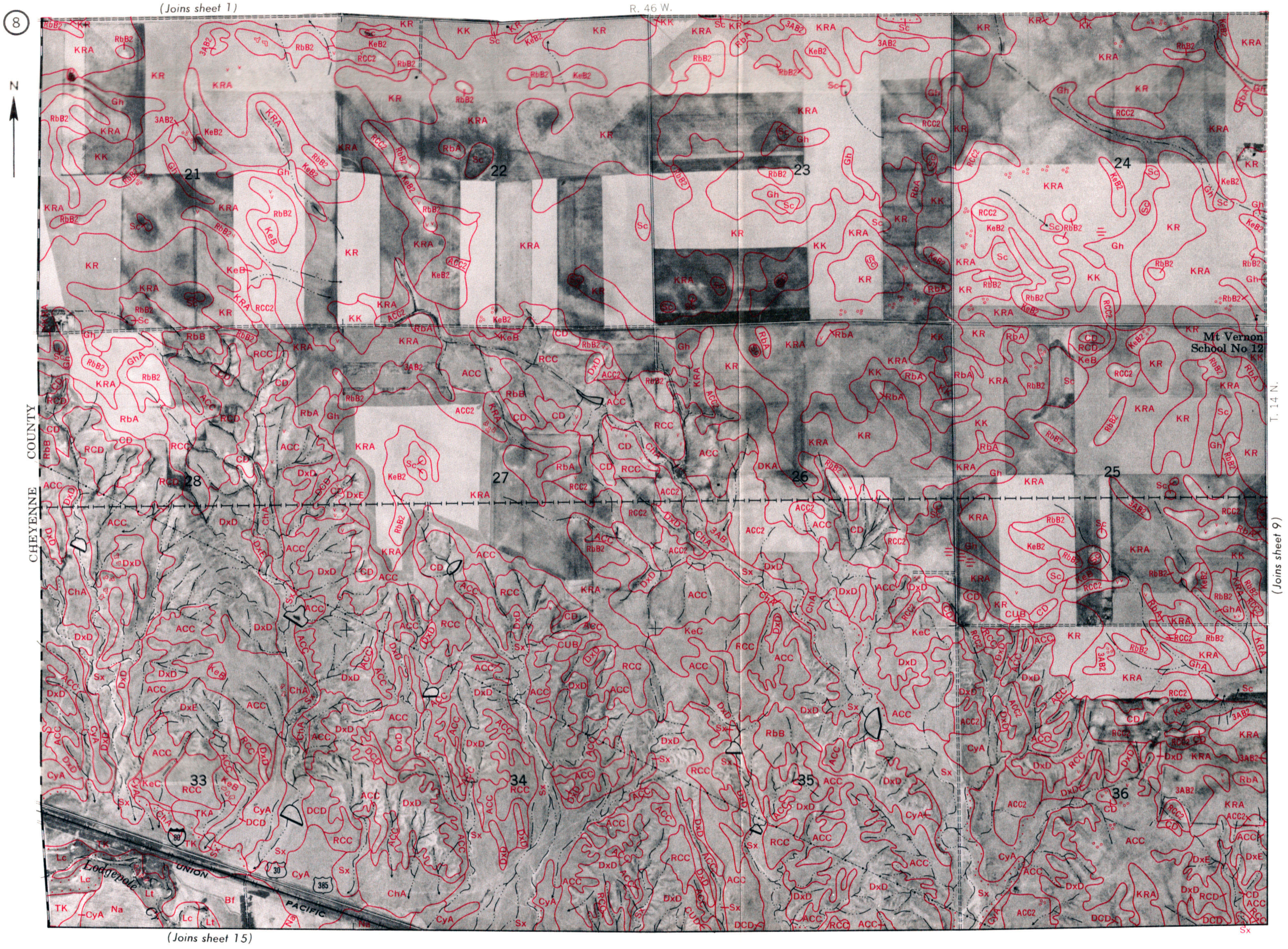

6
N
GARDEN COUNTY
R. 43 W.
R. 42 W.
T. 14 N.
(Joins sheet 5)
(Joins sheet 7)
(Joins sheet 13)
School No 11
0
½
1 Mile
Scale 1:20 000
0
5 000 Feet



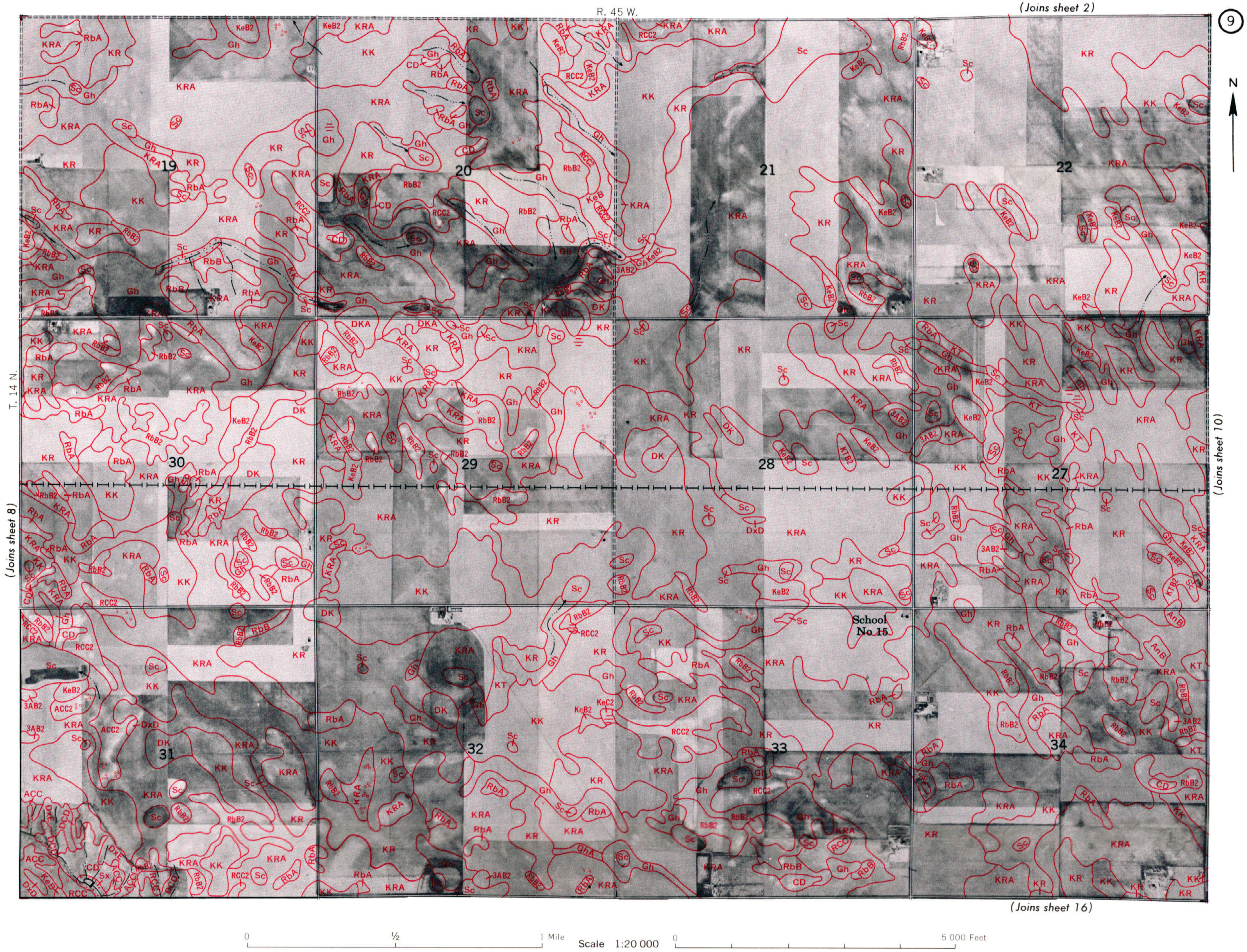
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division.

Range, township, and section corners shown on this map are indefinite.



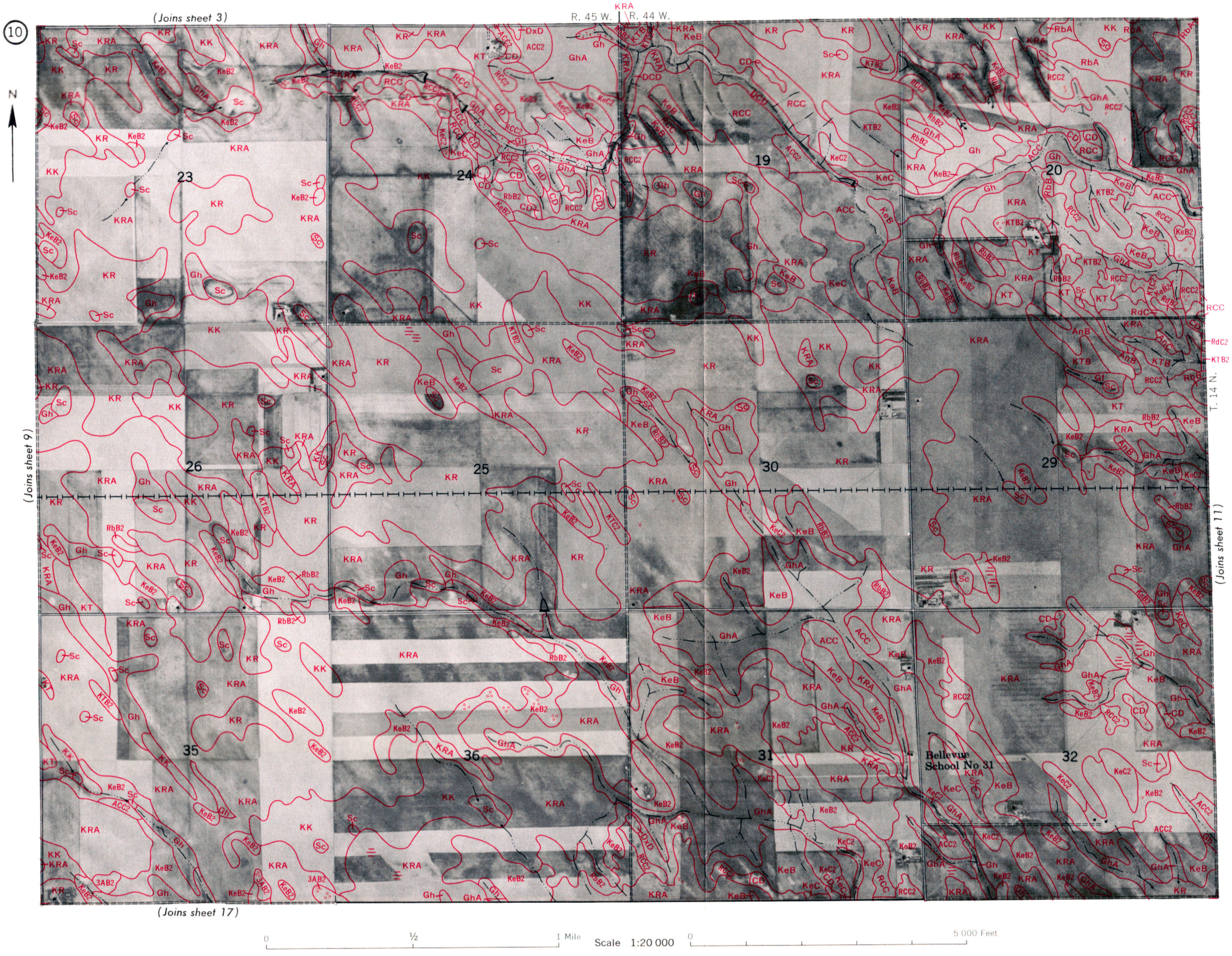
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet



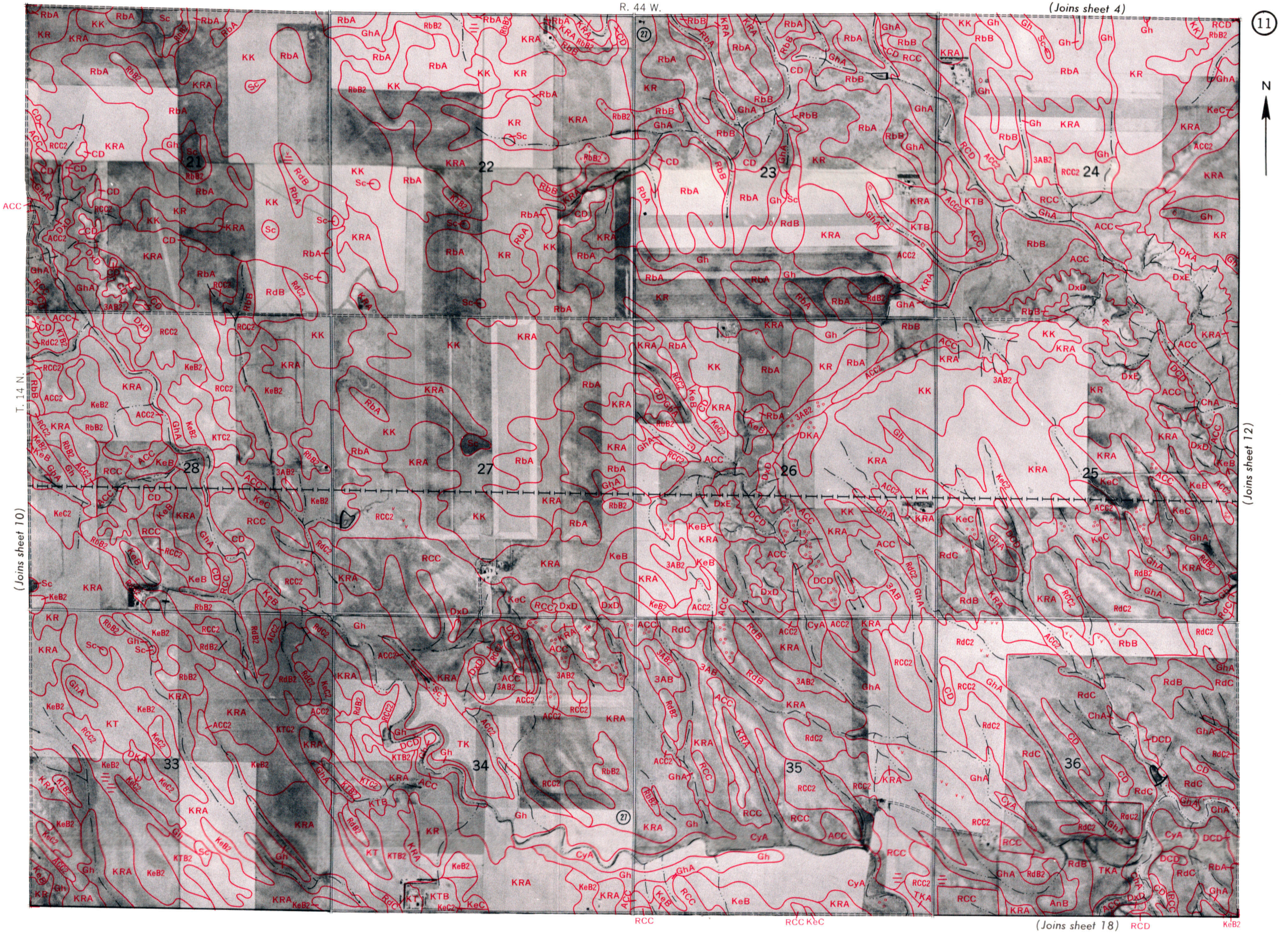
This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division.

Range, township, and section corners shown on this map are indefinite.

DEUEL COUNTY, NEBRASKA — SHEET NUMBER 10



DEUEL COUNTY, NEBRASKA — SHEET NUMBER 11



0 ½ 1 Mile

Scale 1:20 000

0 5 000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division.

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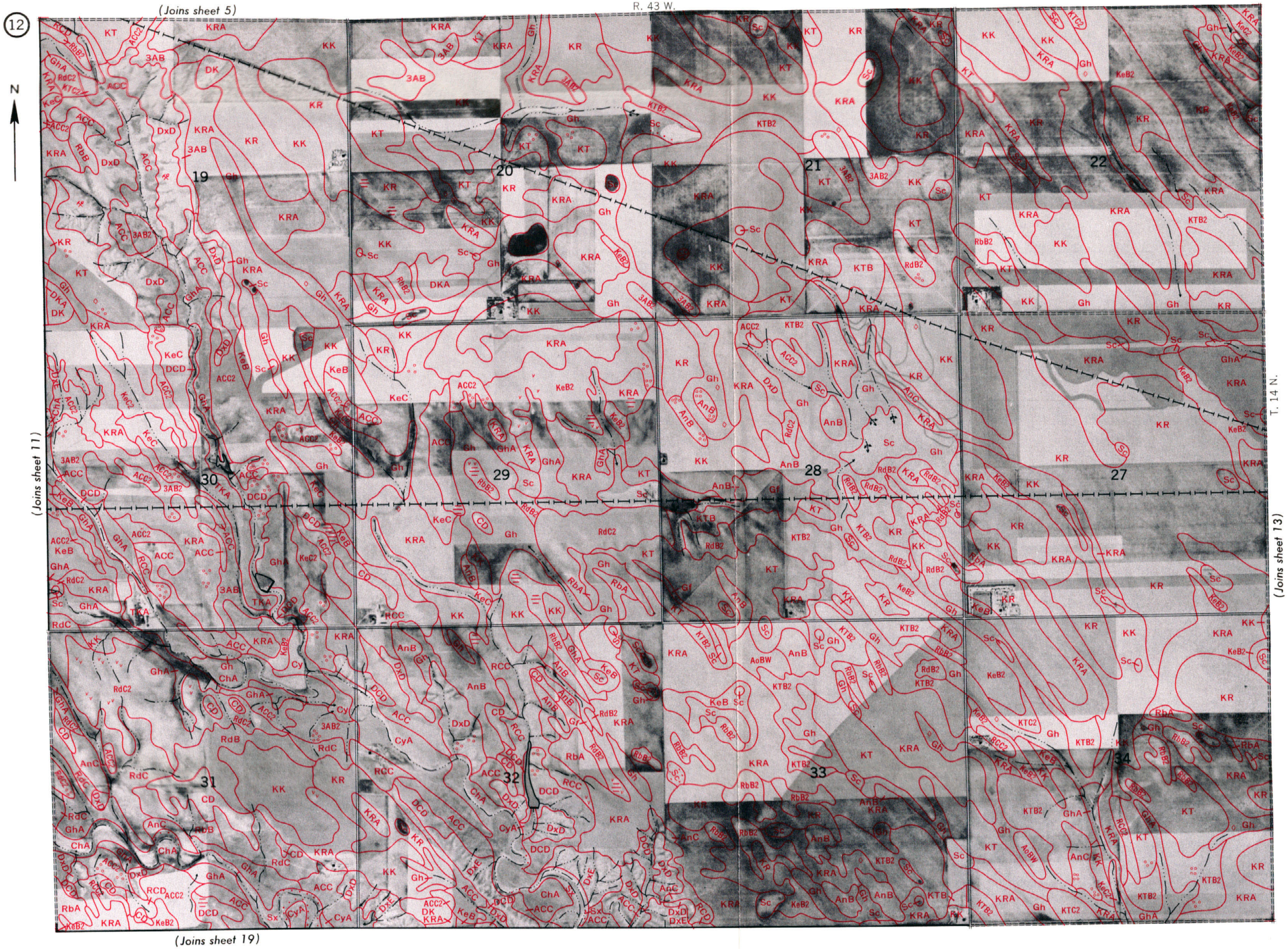
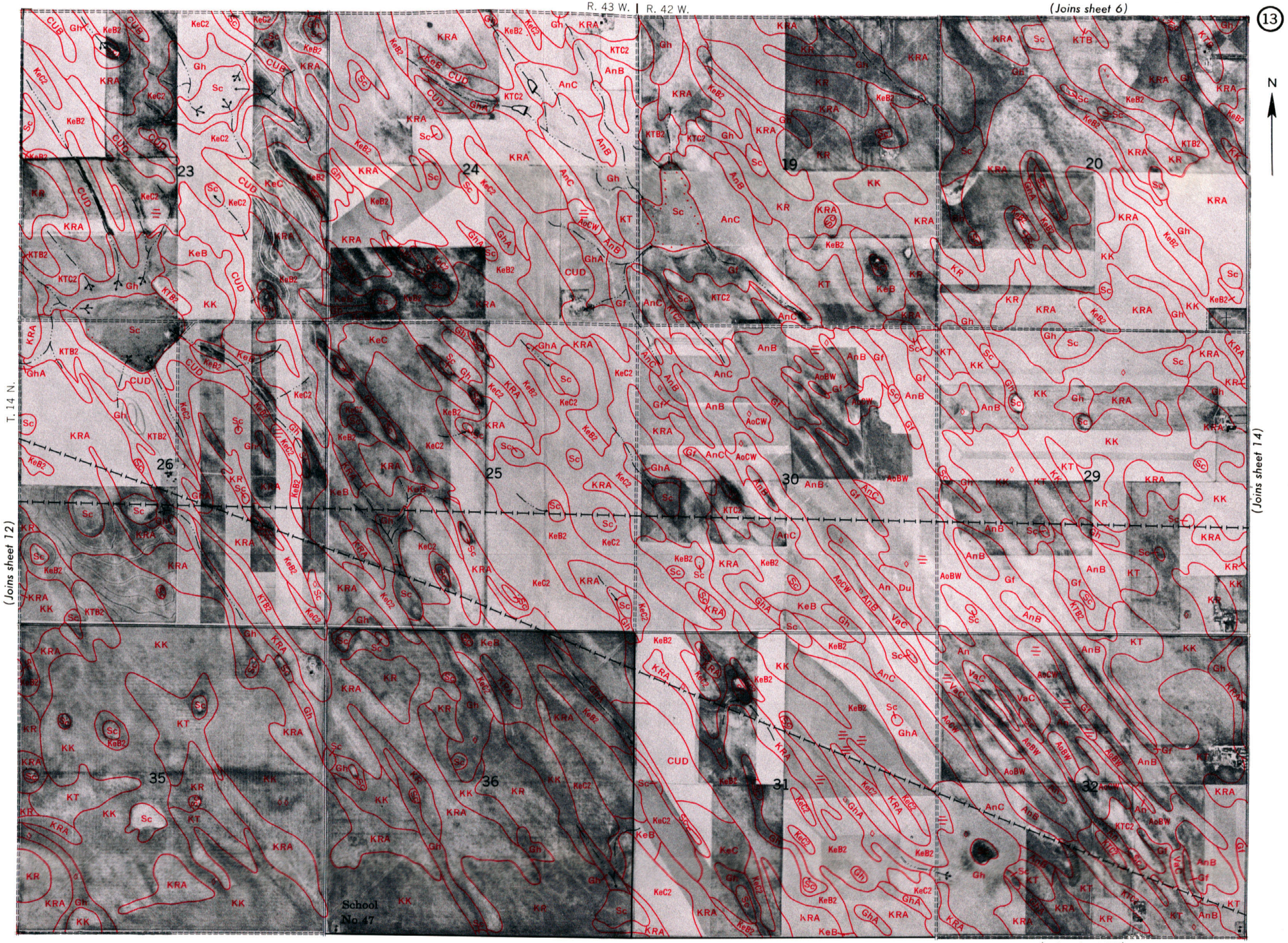
DEUEL COUNTY, NEBRASKA — SHEET NUMBER 12



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

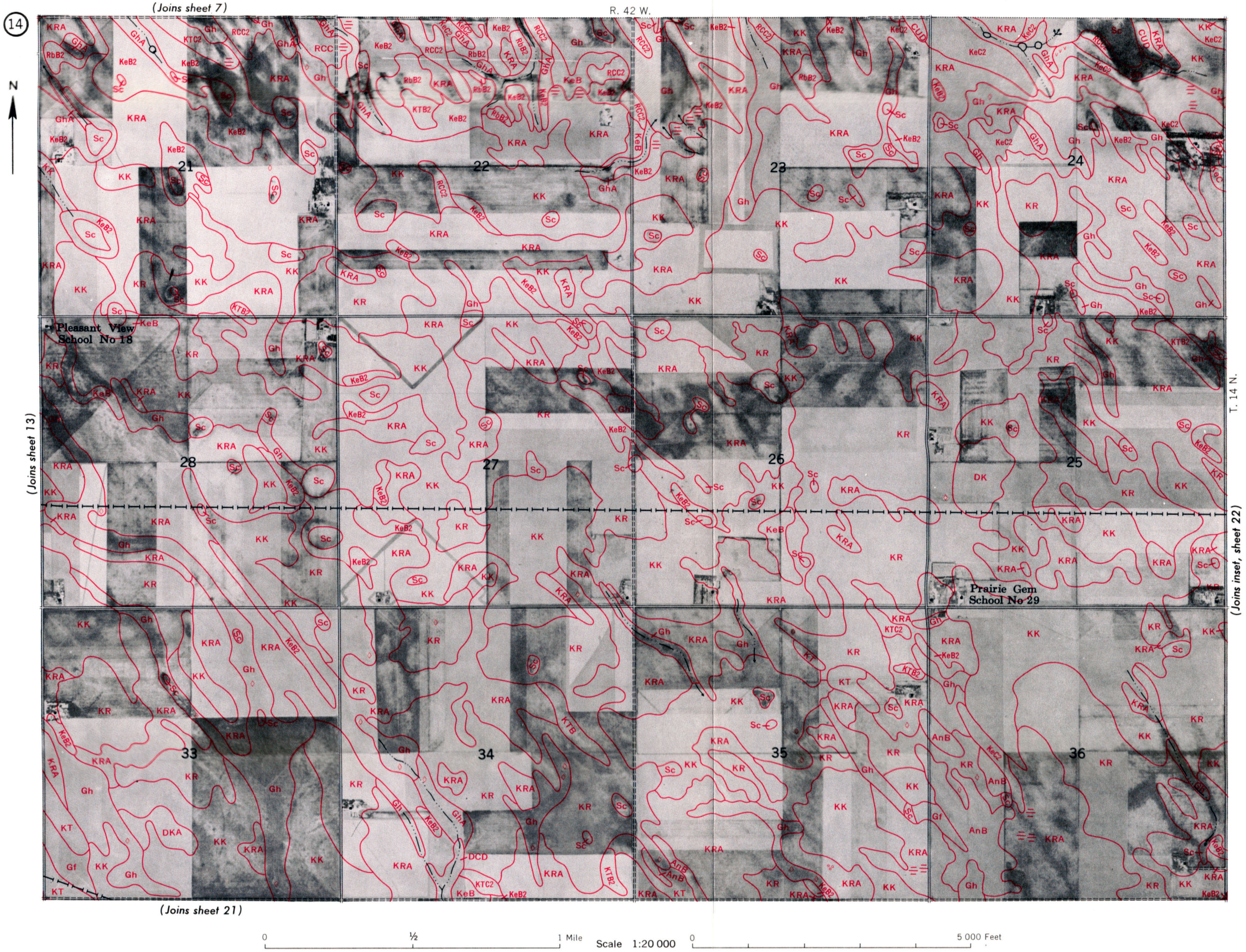
DEUEL COUNTY, NEBRASKA — SHEET NUMBER 13

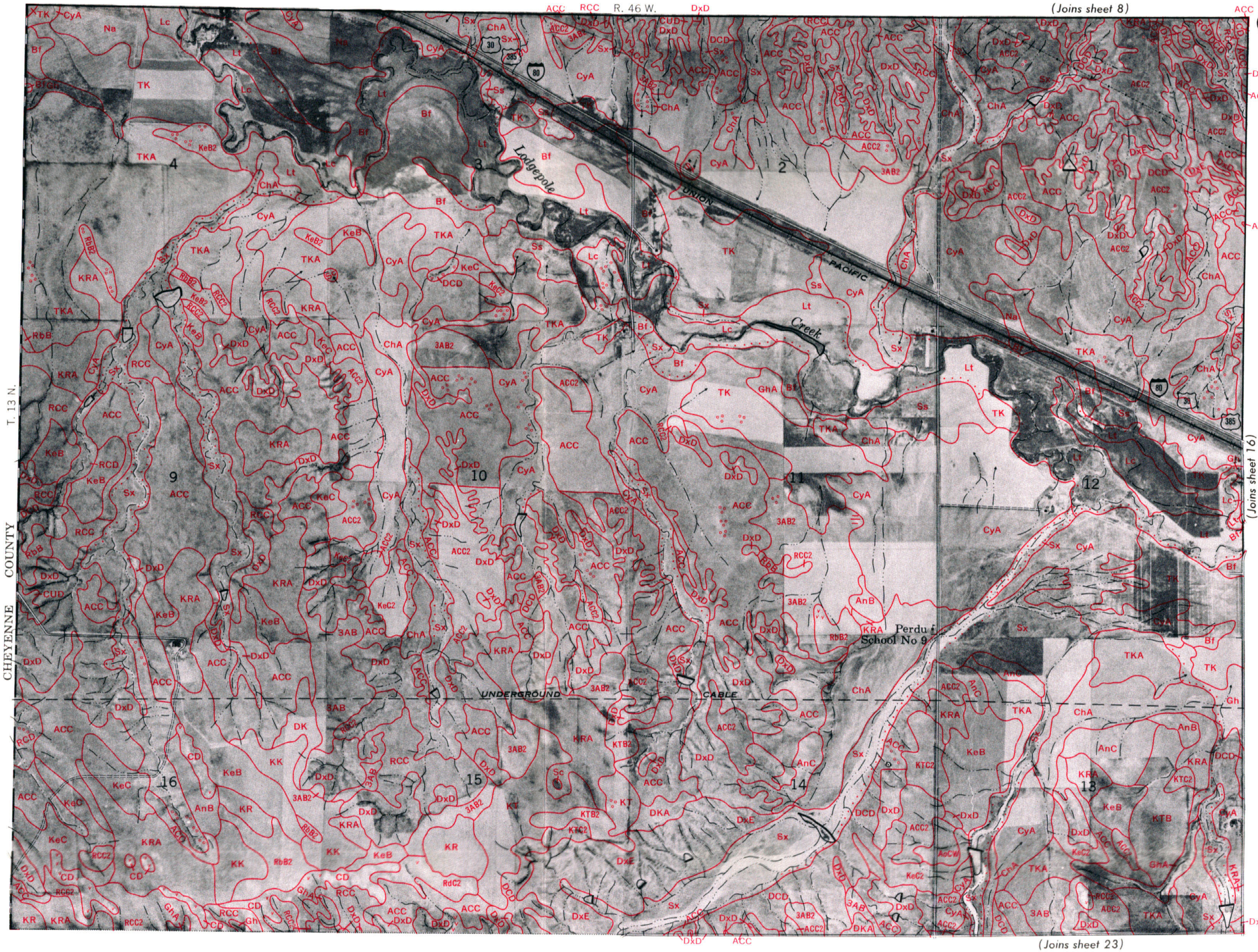


This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

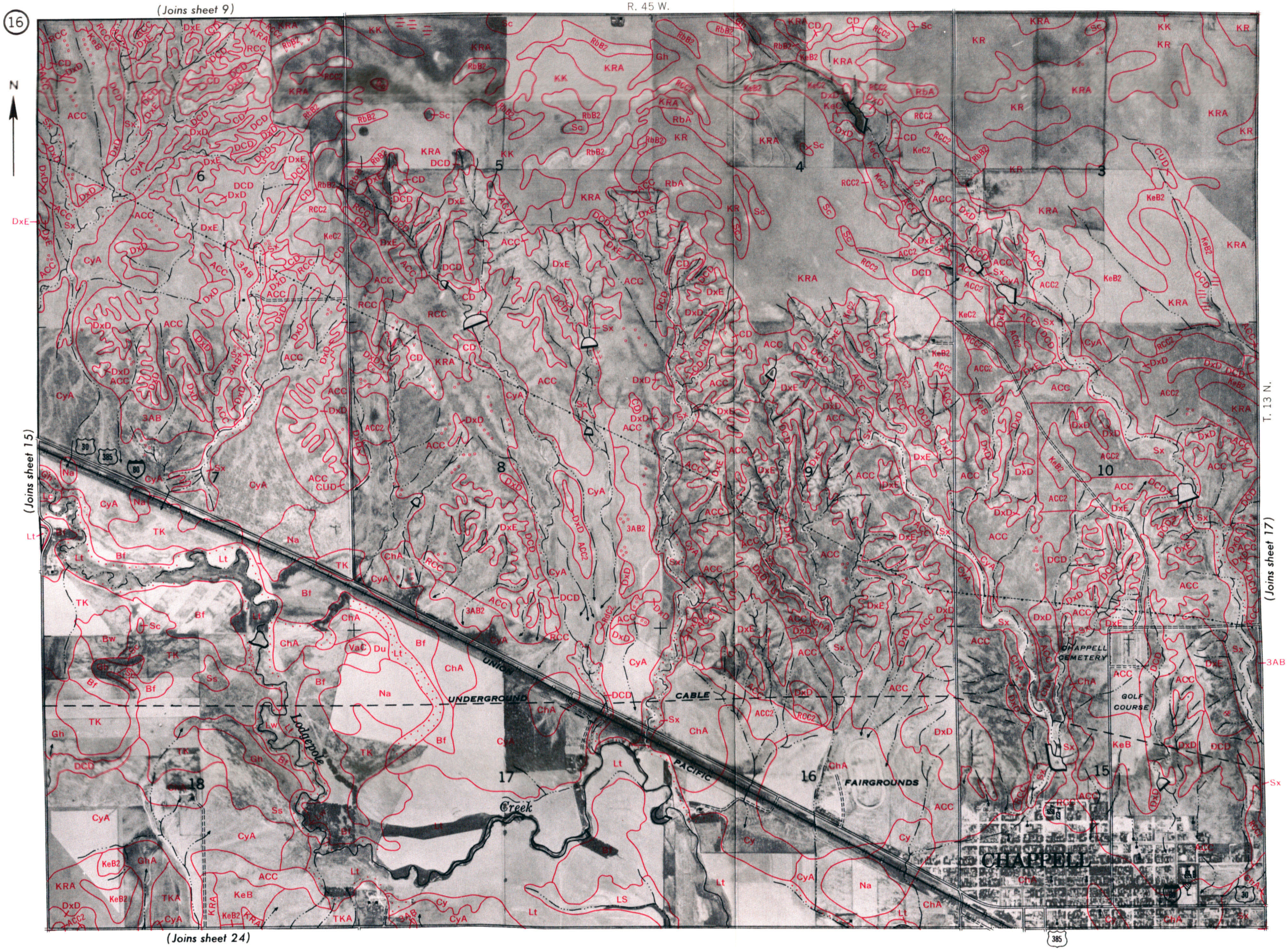

14
(Joins sheet 7)
R. 42 W.
N
(Joins sheet 13)
T. 14 N.
(Joins inset, sheet 22)
(Joins sheet 21)
21
22
23
24
28
27
26
25
33
34
35
36
Pleasant View School No 18
Prairie Gem School No 29
0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet



This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division.

Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

R. 45 W. | R. 44 W.

(Joins sheet 10)

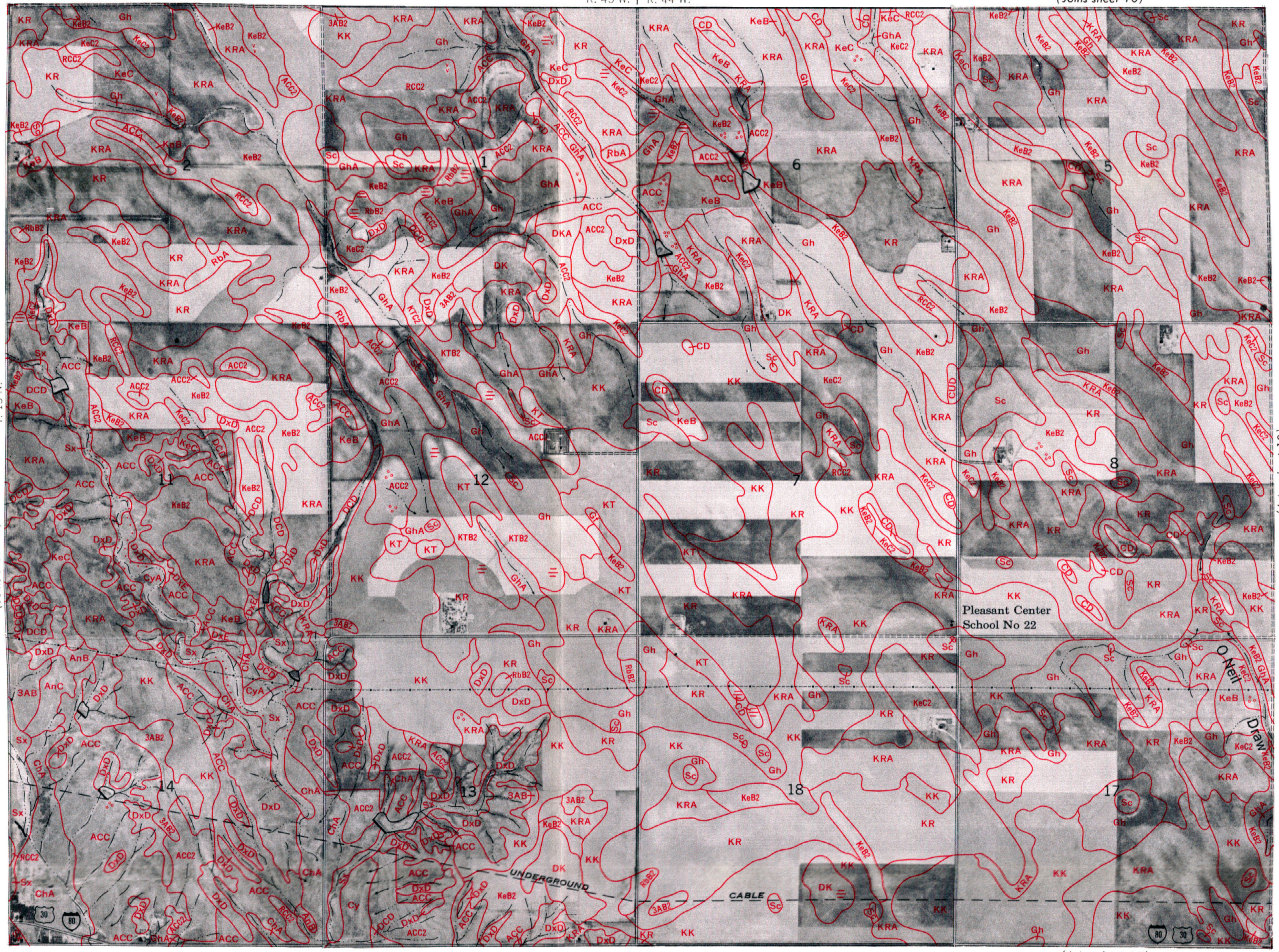
(17)

N

T. 13 N.

(Joins sheet 16)

(Joins sheet 18)



(Joins sheet 25)

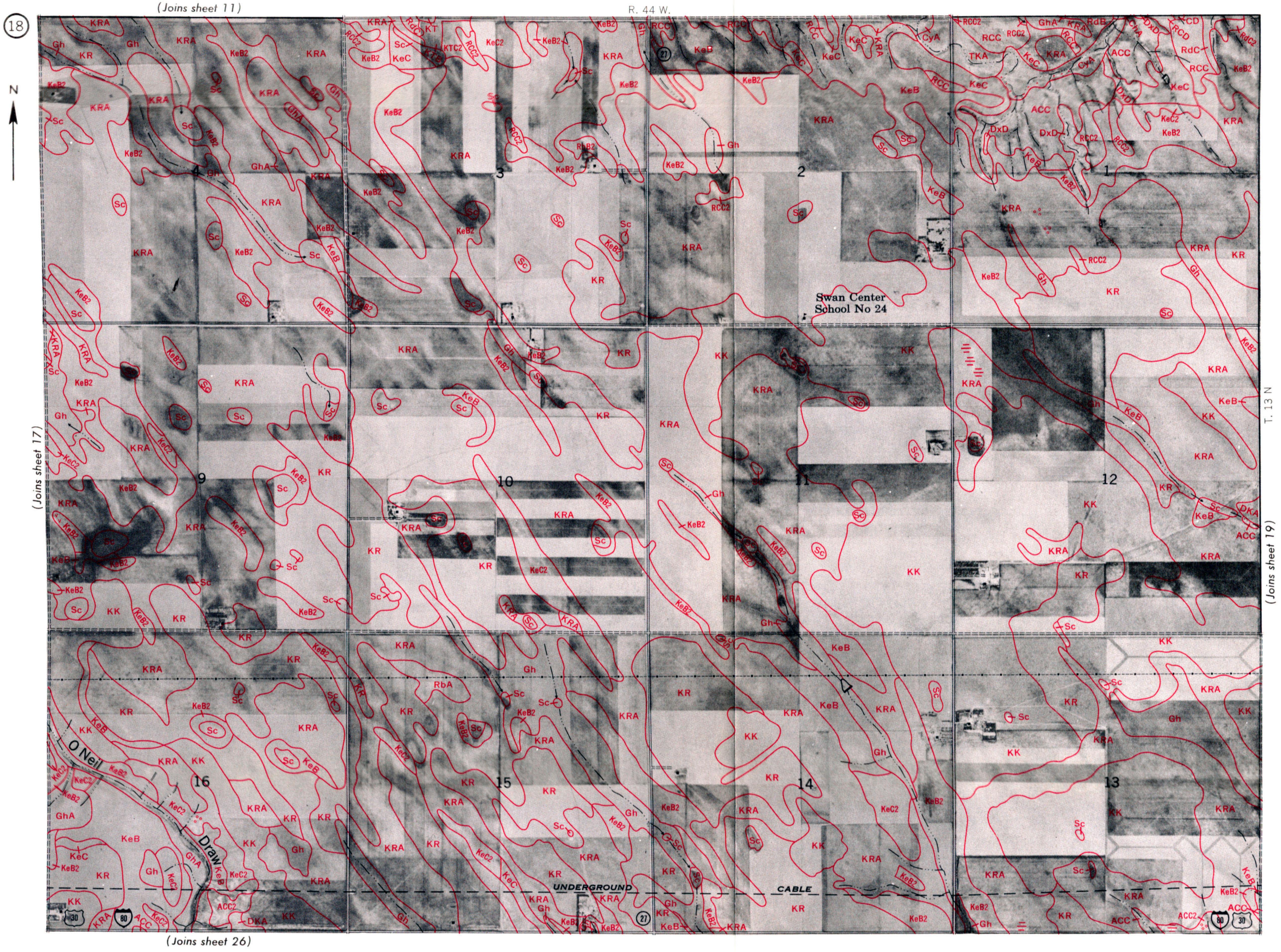
Scale 1:20 000

0 ½ 1 Mile

0 5 000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division

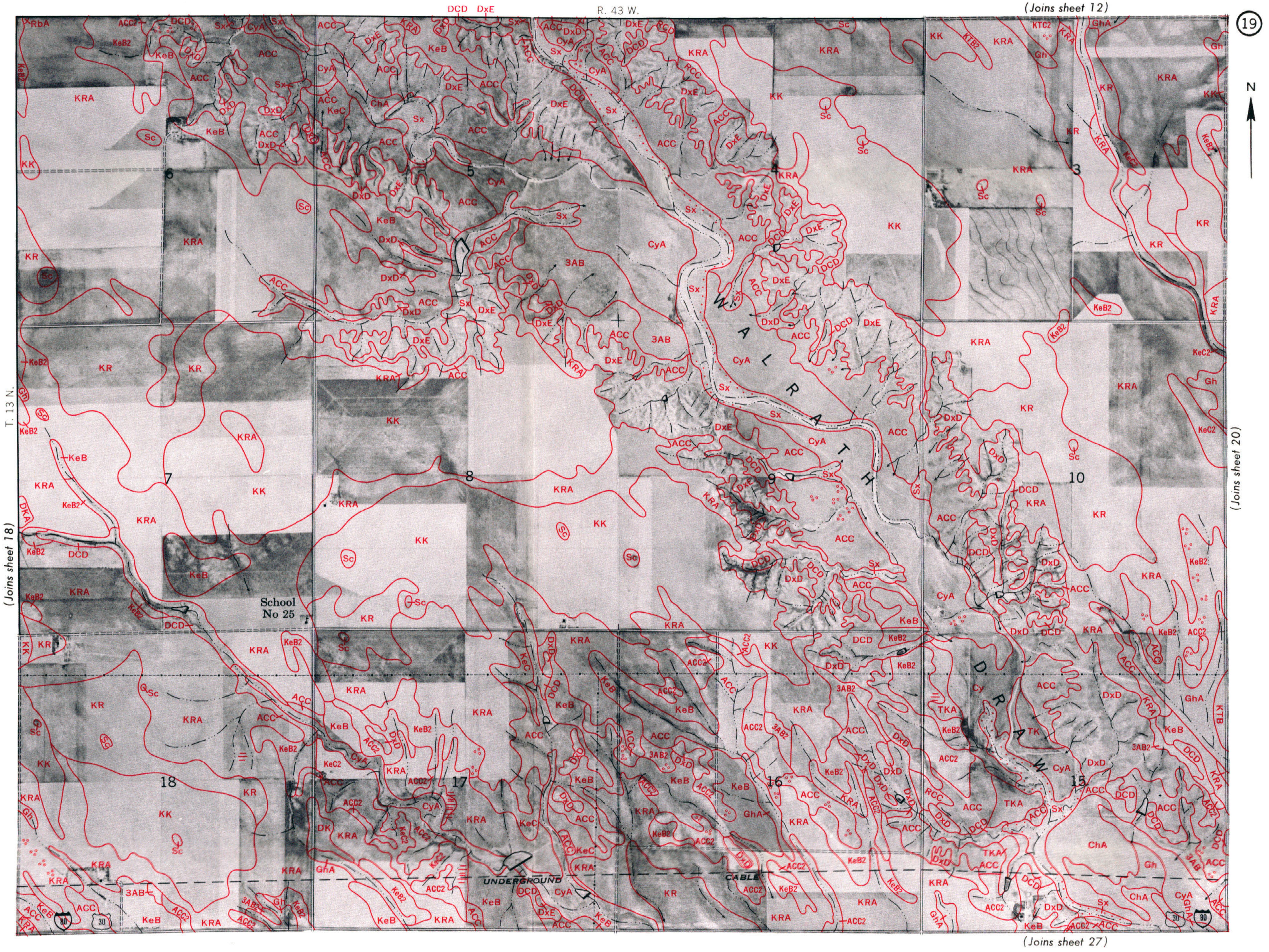
Range, township, and section corners shown on this map are indefinite.



0 ½ 1 Mile Scale 1:20 000 5 000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division.

Range, township, and section corners shown on this map are indefinite.



Scale 1:20 000

0 ½ 1 Mile

0 5 000 Feet

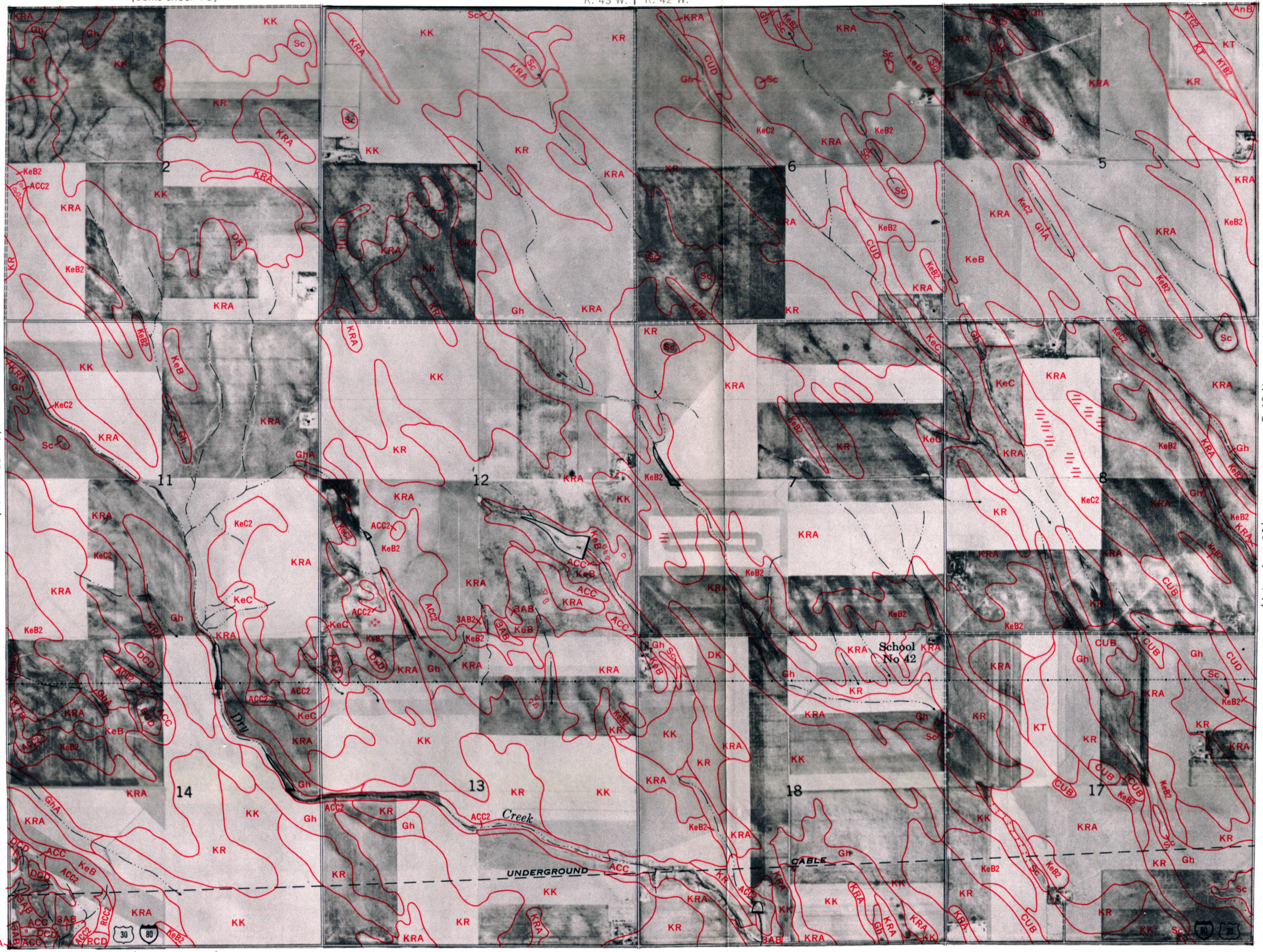
20

(Joins sheet 13)

R. 43 W. | R. 42 W.

N

(Joins sheet 19)



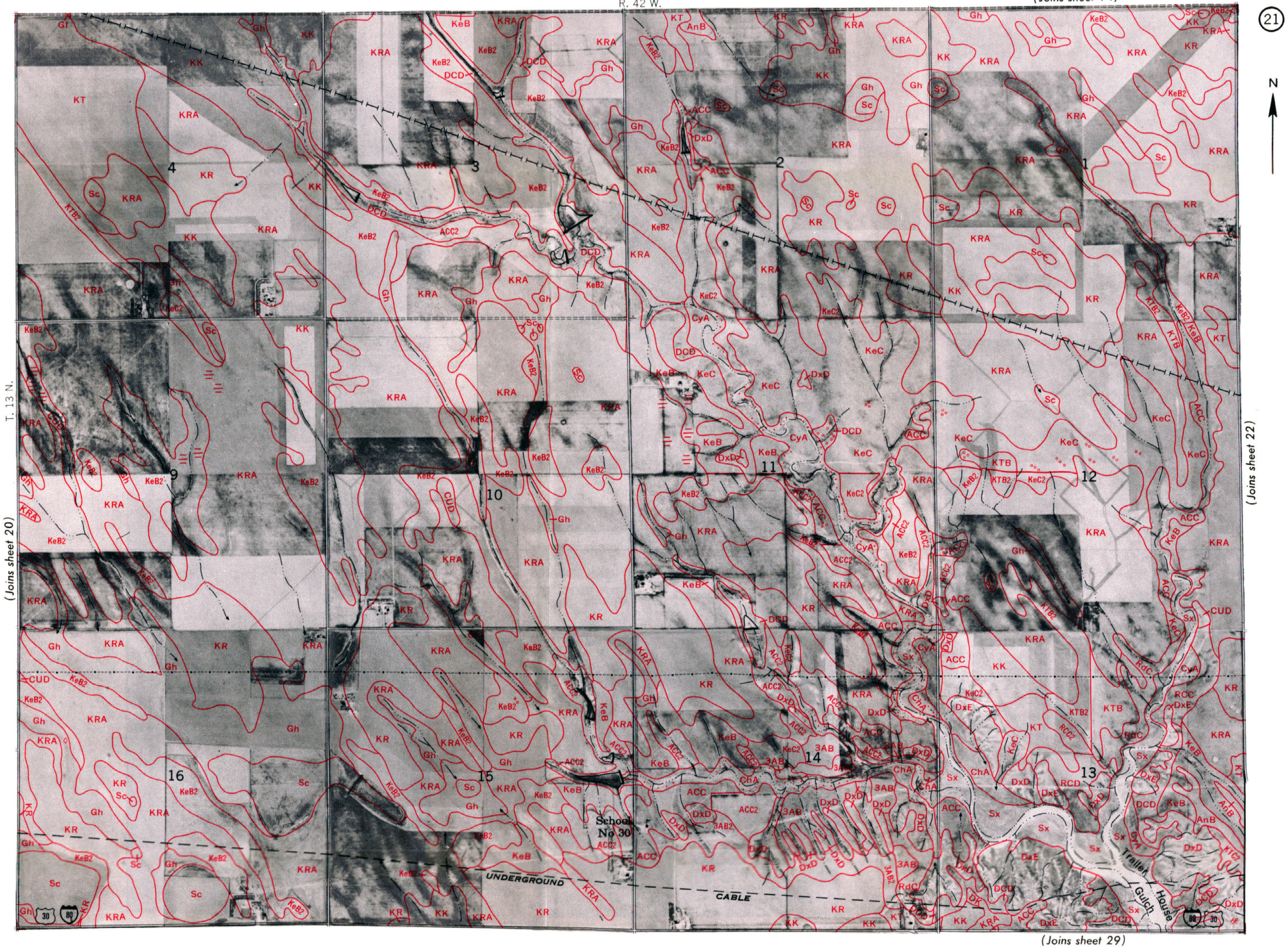
T. 13 N.

(Joins sheet 21)

(Joins sheet 28)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

DEUEL COUNTY, NEBRASKA — SHEET NUMBER 21



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division

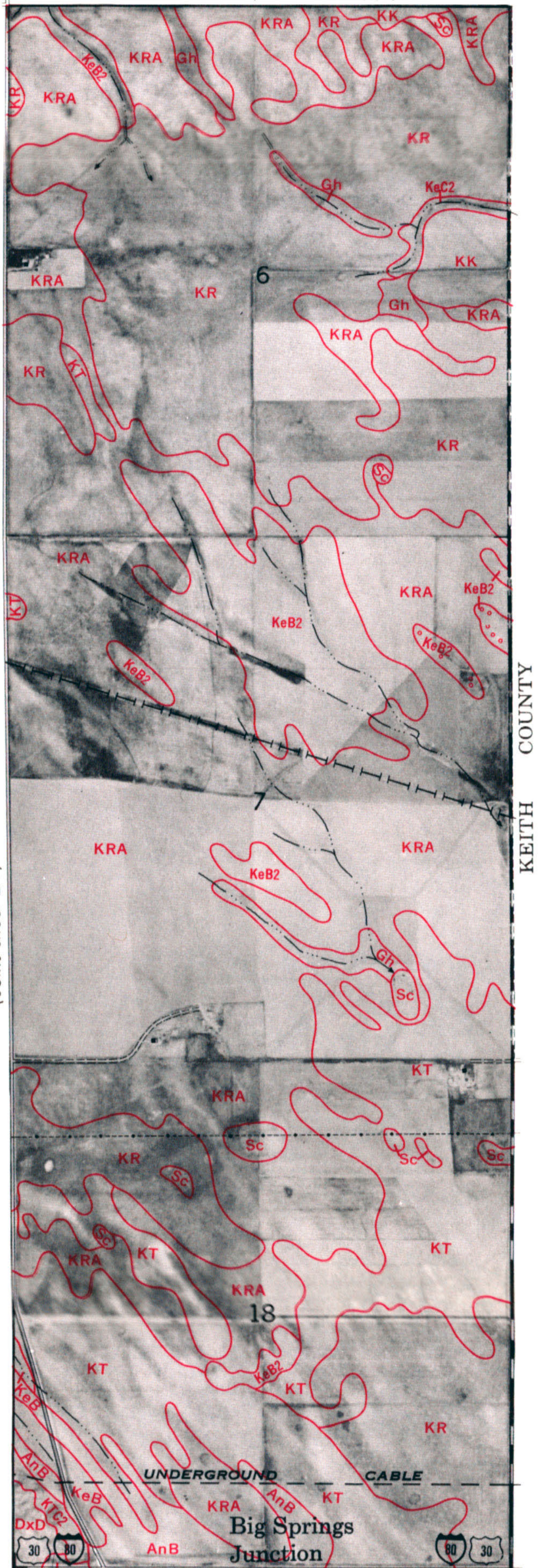
Range, township, and section corners shown on this map are indefinite.

22

(Joins lower center) R. 41 W.

T. 13 N.

(Joins sheet 21)

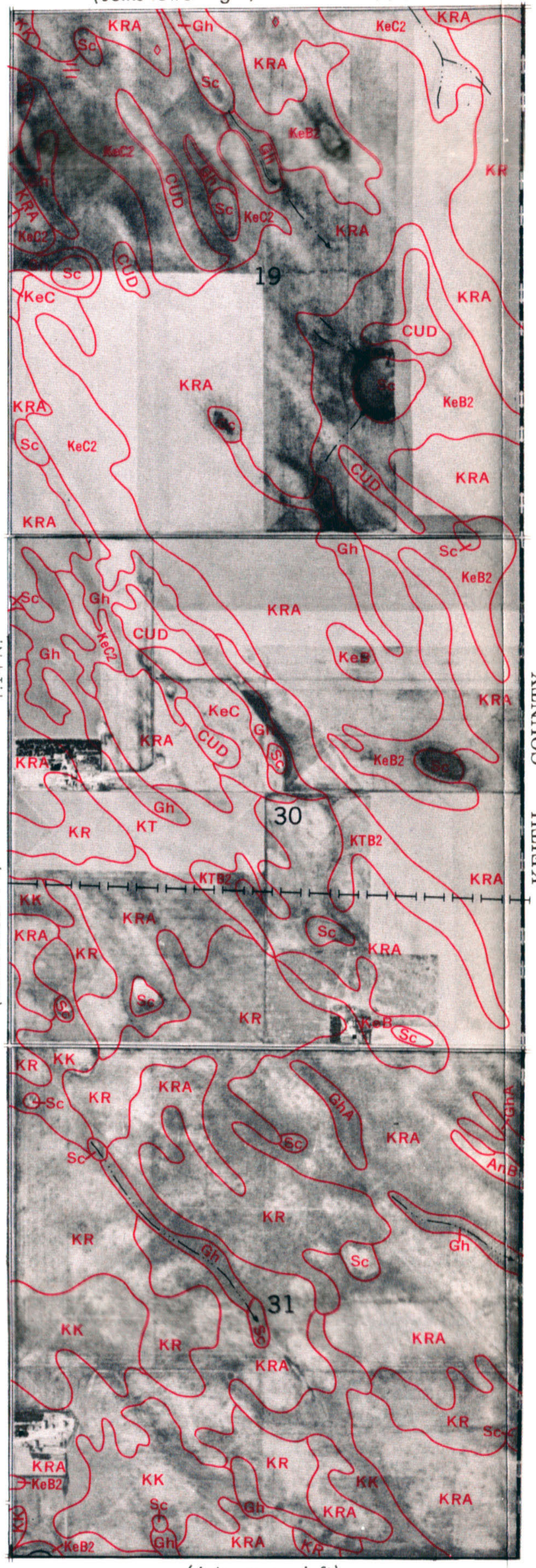


(Joins inset, sheet 37)

(Joins lower right) R. 41 W.

T. 14 N.

(Joins sheet 14)

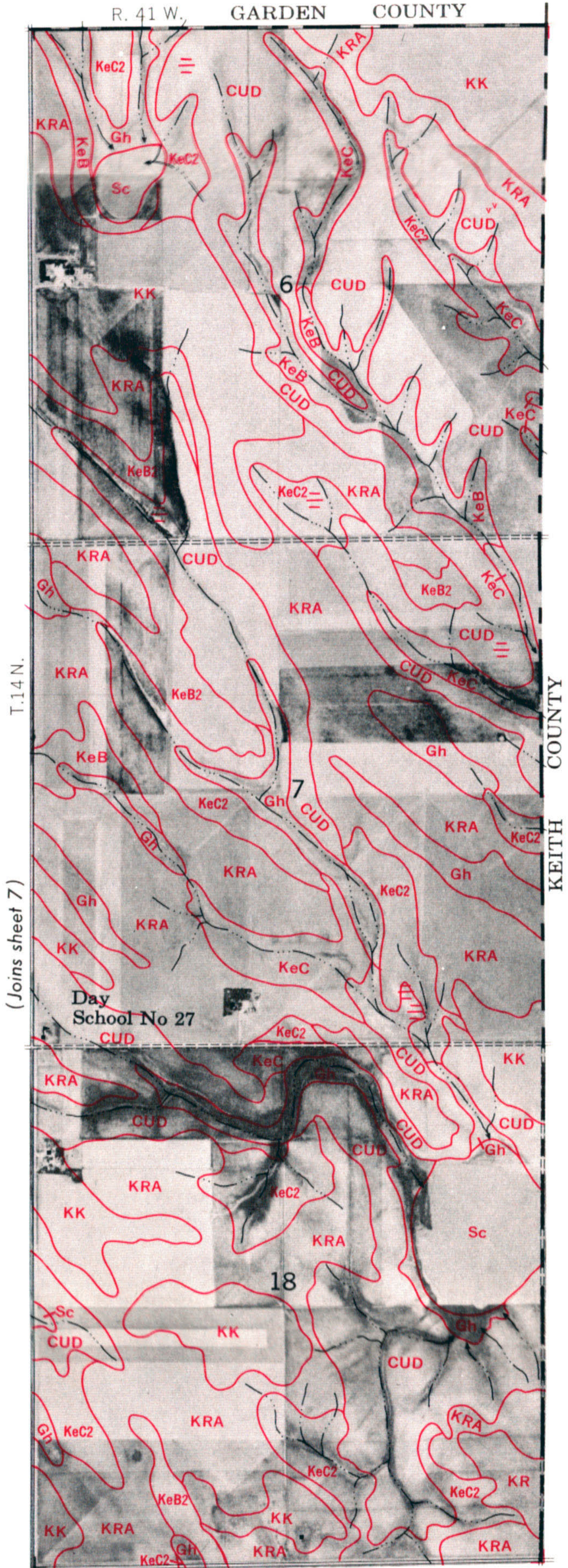


(Joins upper left)

R. 41 W. GARDEN COUNTY

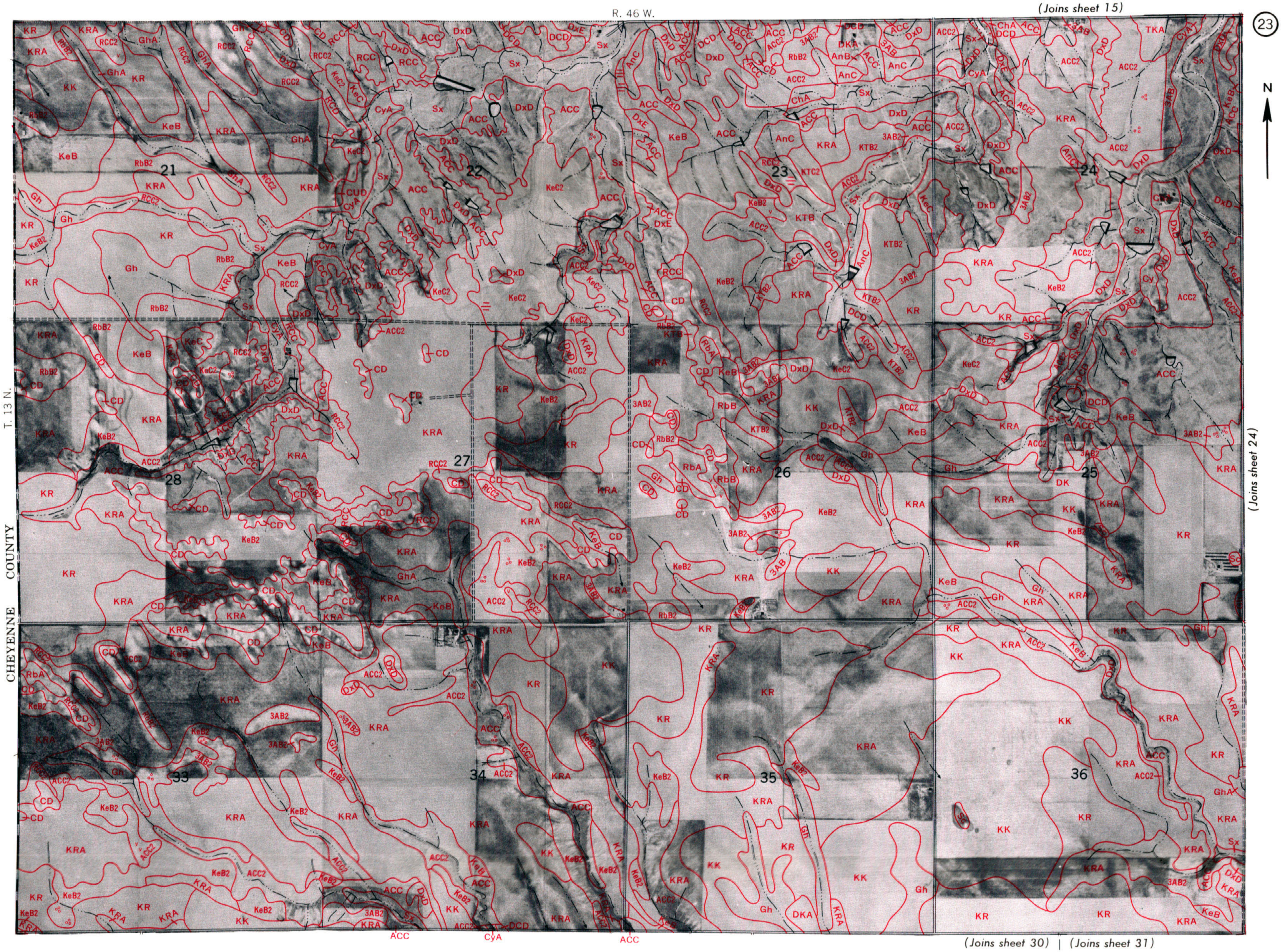
T. 14 N.

(Joins sheet 7)



(Joins upper center)

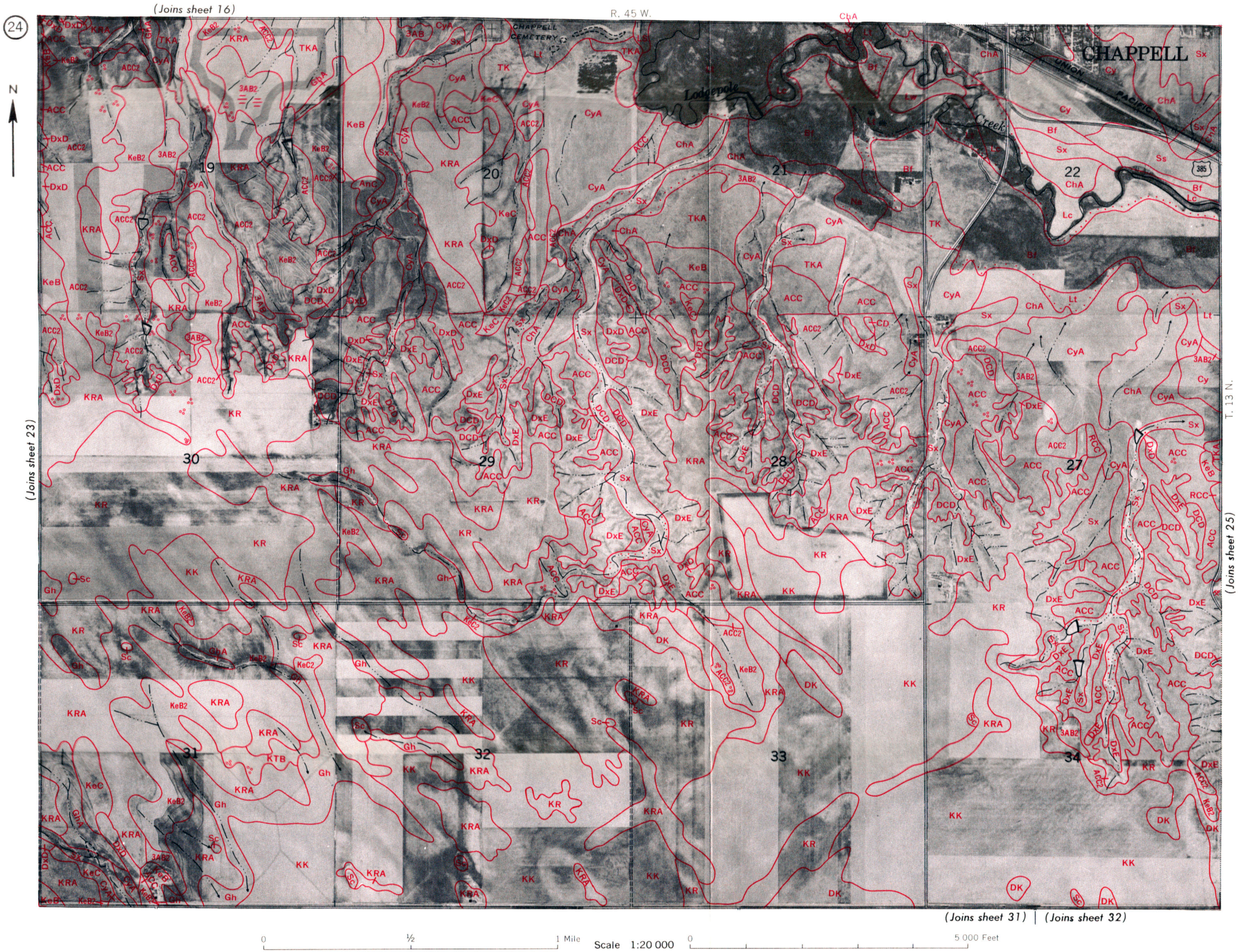
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet



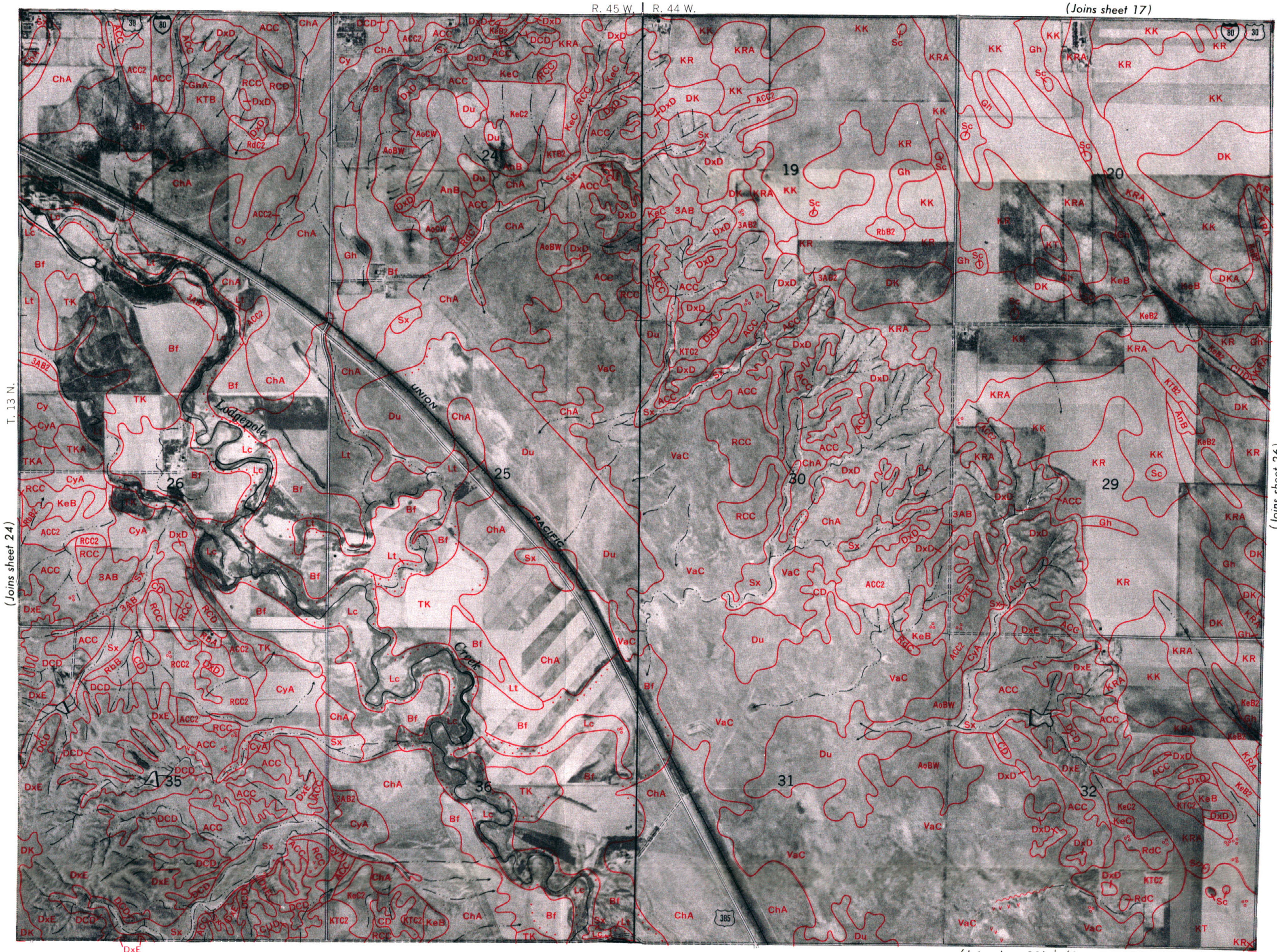
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

This map is one of a set compiled in 1964 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the University of Nebraska, Conservation and Survey Division.

Range, township, and section corners shown on this map are indefinite.


24
(Joins sheet 16)
R. 45 W.
N
CHAPPELL
CHAPPELL CEMETERY
UNION PACIFIC
Lodgepole
Creek
385
T. 13 N.
(Joins sheet 23)
(Joins sheet 25)
19
20
21
22
30
29
28
27
31
32
33
34
(Joins sheet 31) | (Joins sheet 32)
0 ½ 1 Mile
Scale 1:20 000
0 5 000 Feet

(Joins sheet 17)



(Joins sheet 24)

(Joins sheet 26)

(Joins sheet 32) | (Joins sheet 33)

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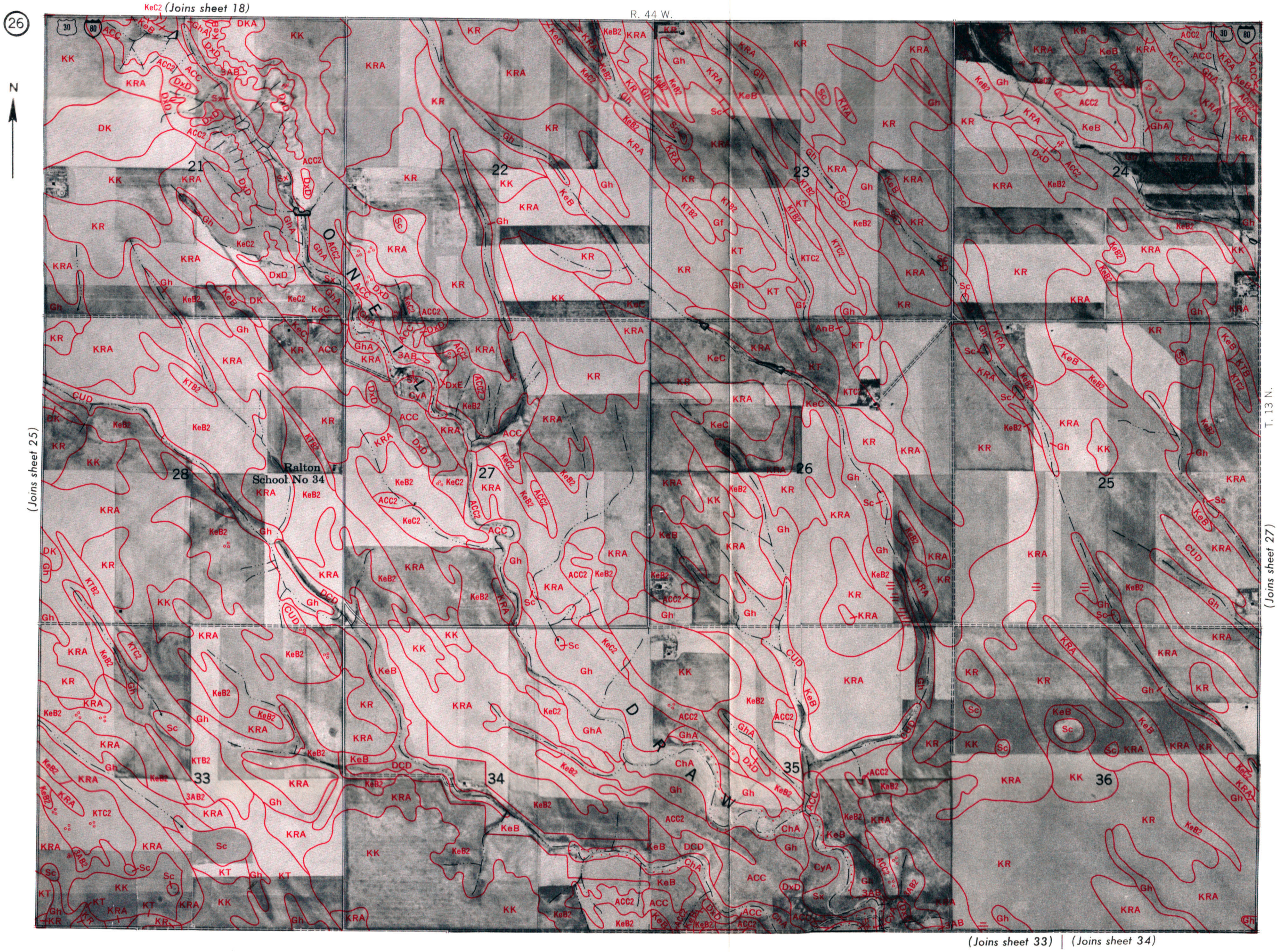
Range, township, and section corners shown on this map are indefinite.

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

R. 43 W.

(Joins sheet 19)

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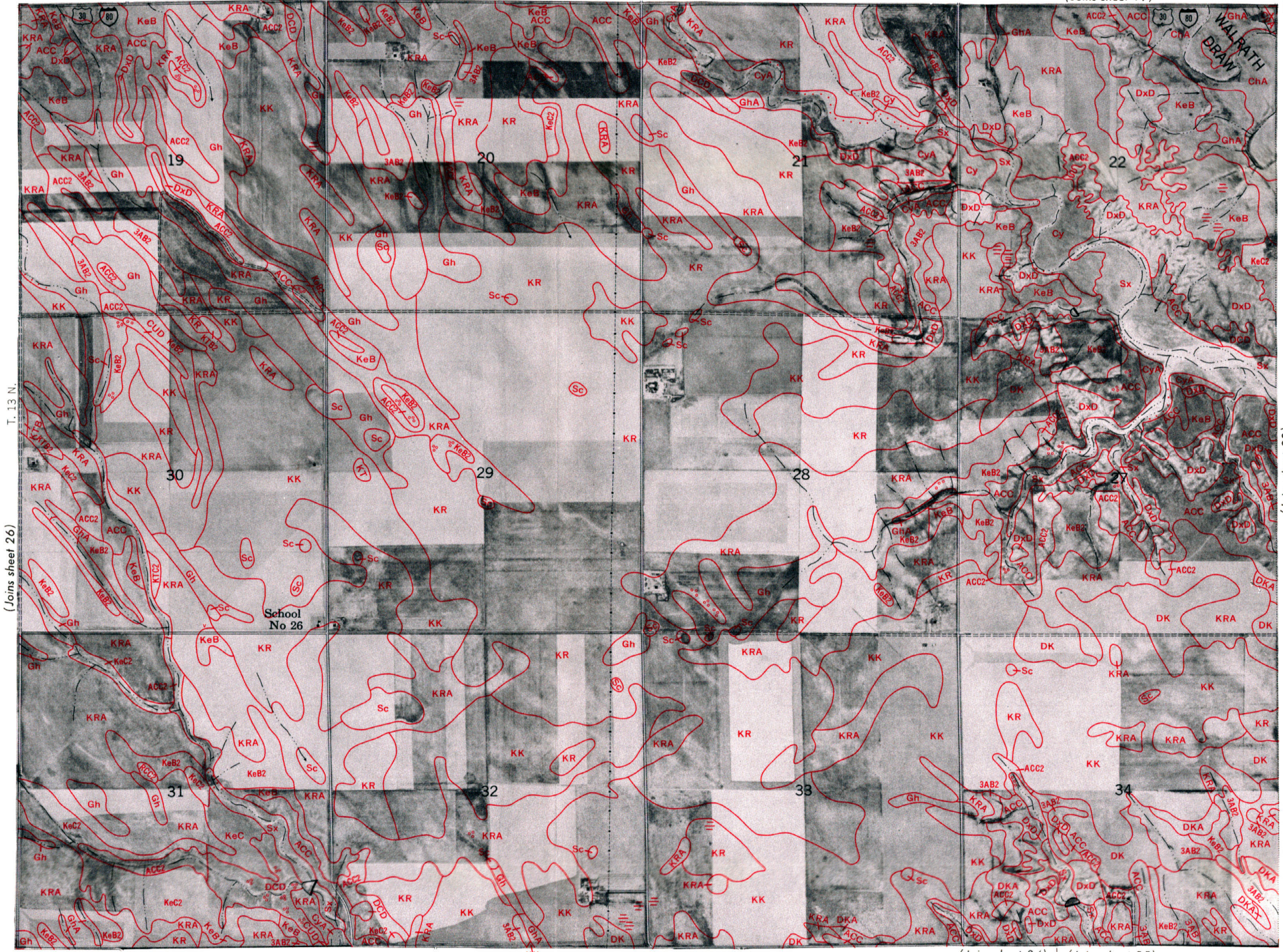
Range, township, and section corners shown on this map are indefinite.

T. 13 N.

(Joins sheet 26)



(Joins sheet 28)

(Joins sheet 34) | (Joins sheet 35)

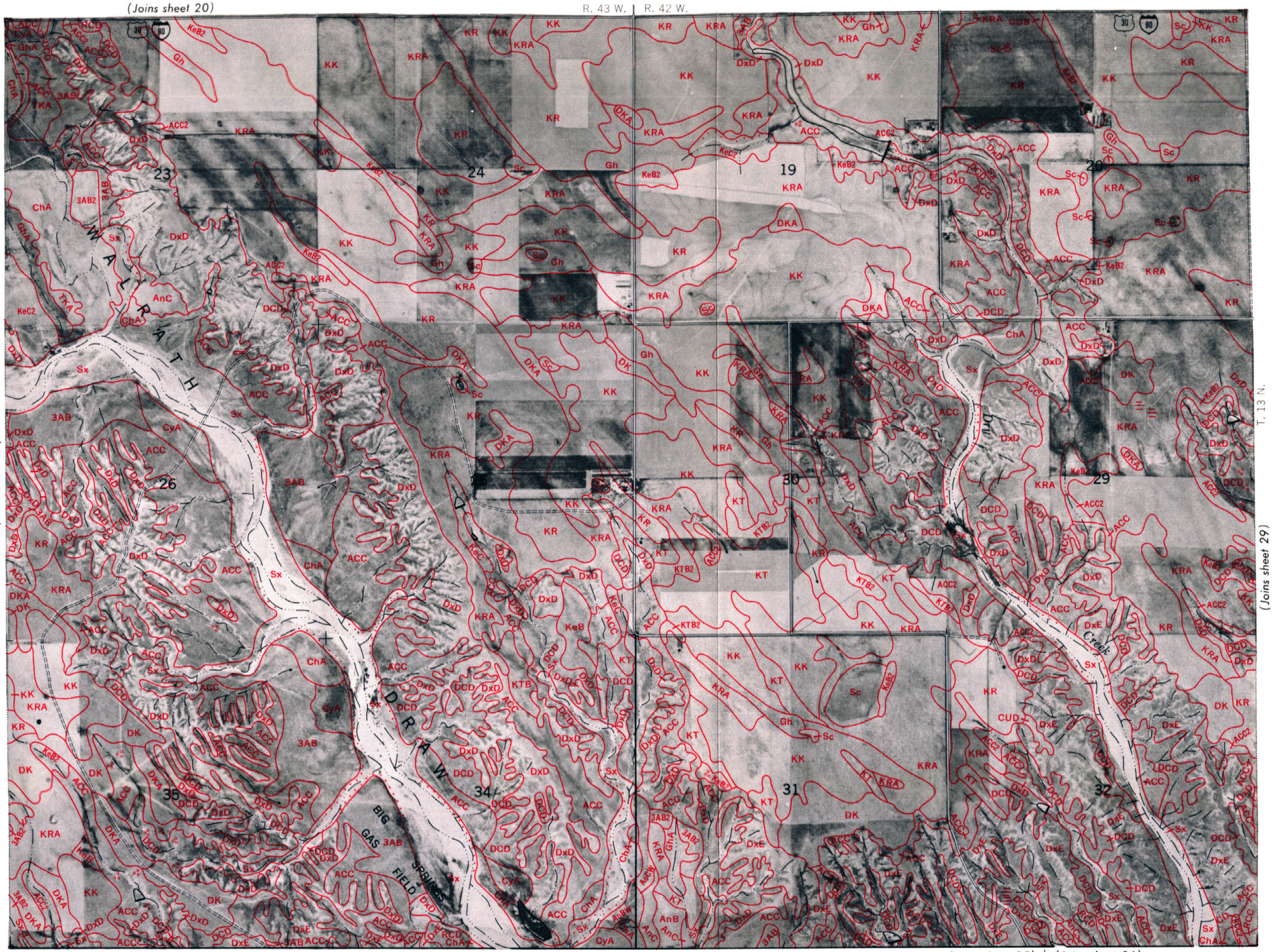
0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

DEUEL COUNTY, NEBRASKA — SHEET NUMBER 28

28

(Joins sheet 20)

R. 43 W. | R. 42 W.

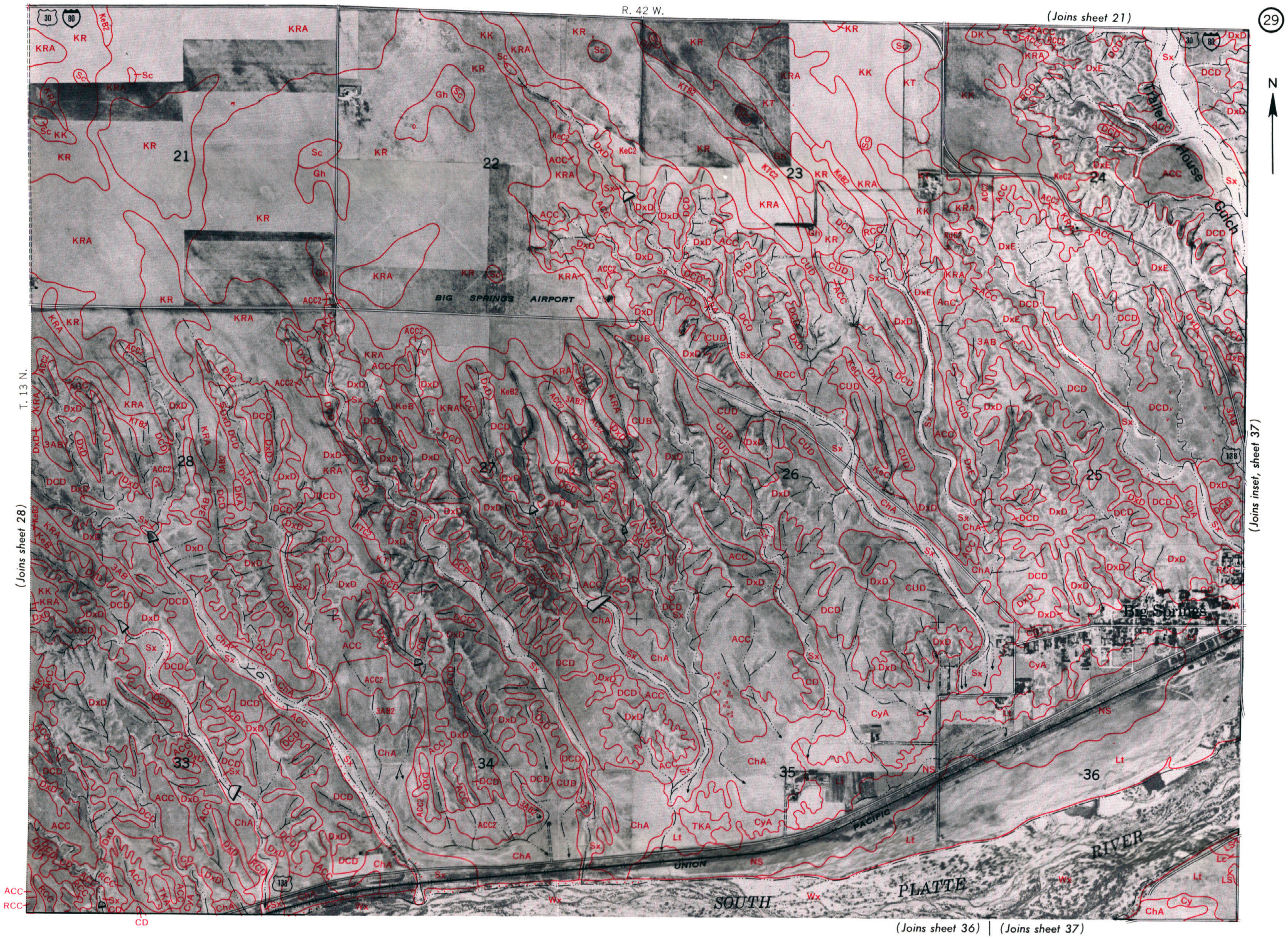


(Joins sheet 27)

(Joins sheet 29)

(Joins sheet 35) | (Joins sheet 36)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet



Scale 1:20 000

0 ½ 1 Mile

0 5 000 Feet

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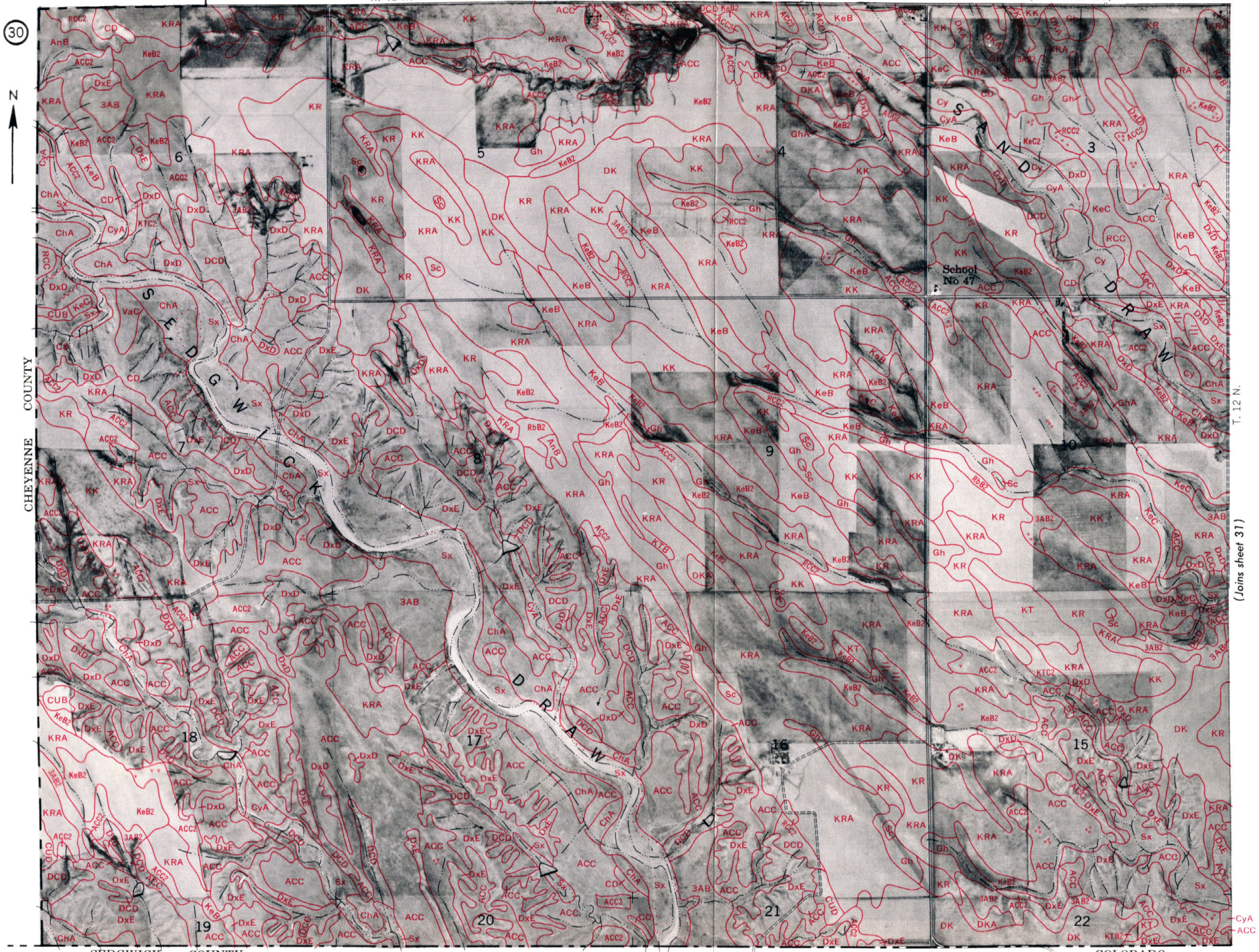
Range, township, and section corners shown on this map are indefinite.

30

R. 46 W. DEUEL COUNTY, NEBRASKA — SHEET NUMBER 30 *(Joins sheet 23)*



0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

(Joins sheet 23) | (Joins sheet 24)

R. 46 W. | R. 45 W.

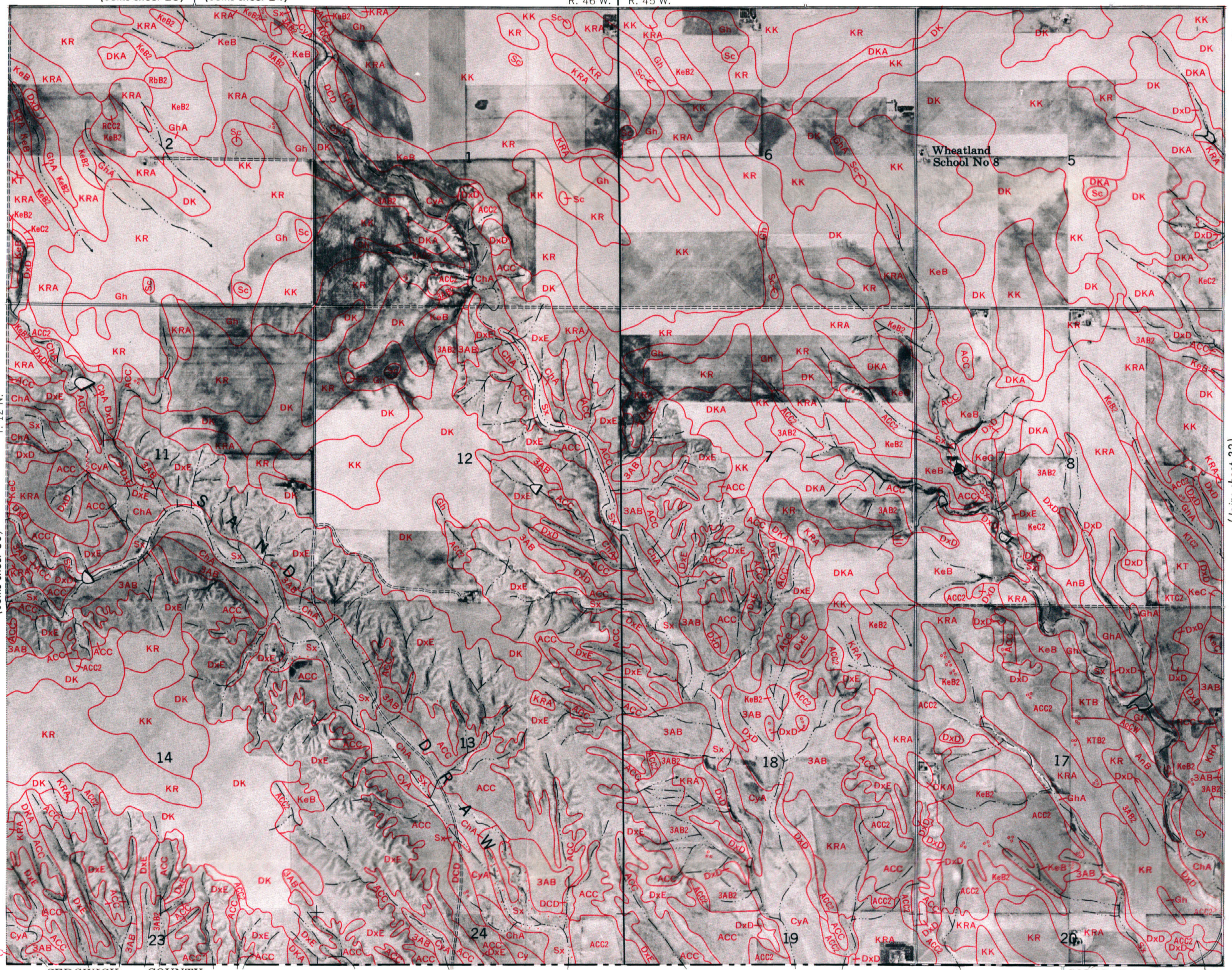
(31)

N

T. 12 N.

(Joins sheet 30)

(Joins sheet 32)



SEDGWICK COUNTY

COLORADO

Scale 1:20 000

0 ½ 1 Mile

0 5 000 Feet

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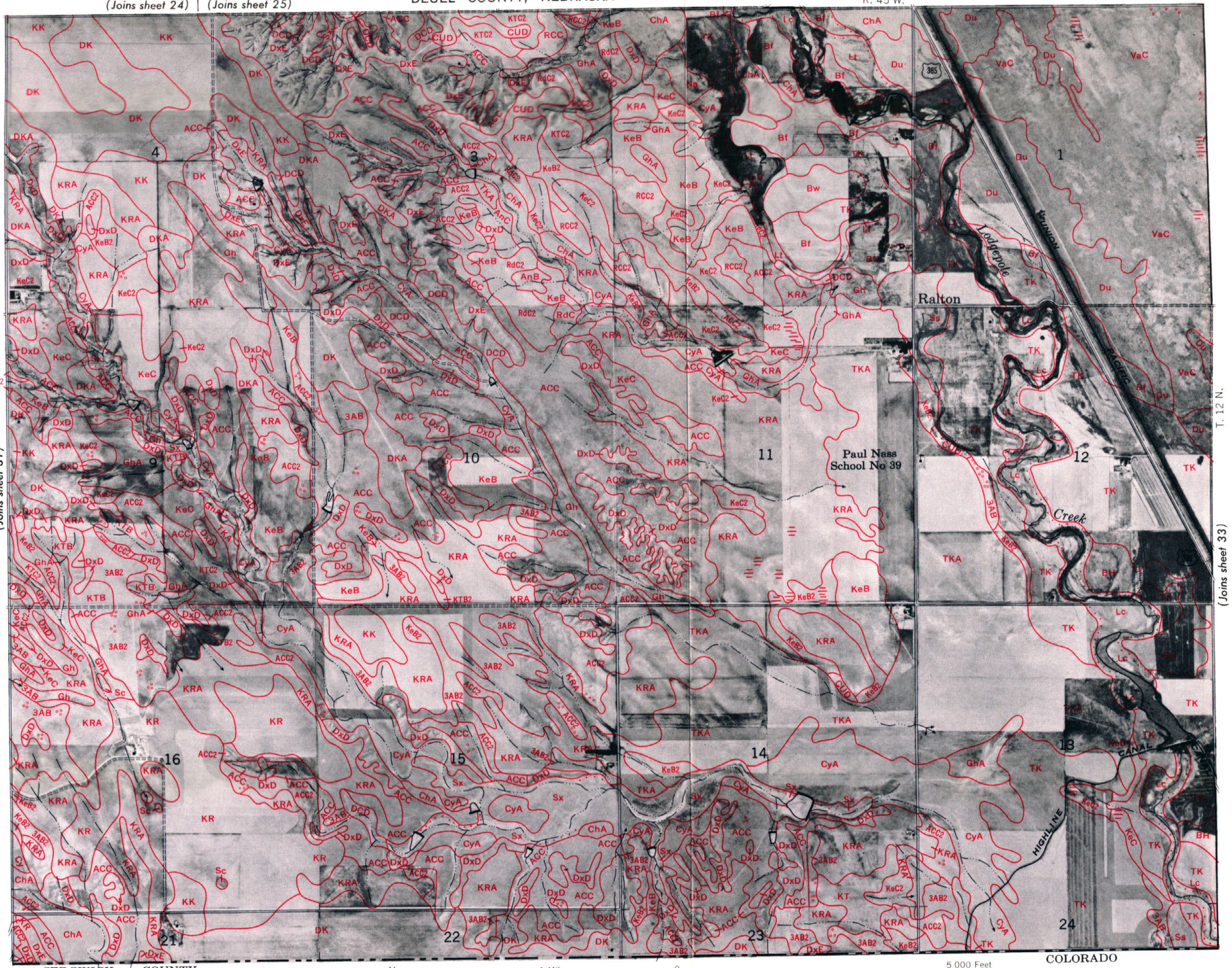
Range, township, and section corners shown on this map are indefinite.

(Joins sheet 24) | (Joins sheet 25)

DEUEL COUNTY, NEBRASKA — SHEET NUMBER 32

R. 45 W.

(Joins sheet 31)



T. 12 N.

(Joins sheet 33)

SEDGWICK COUNTY

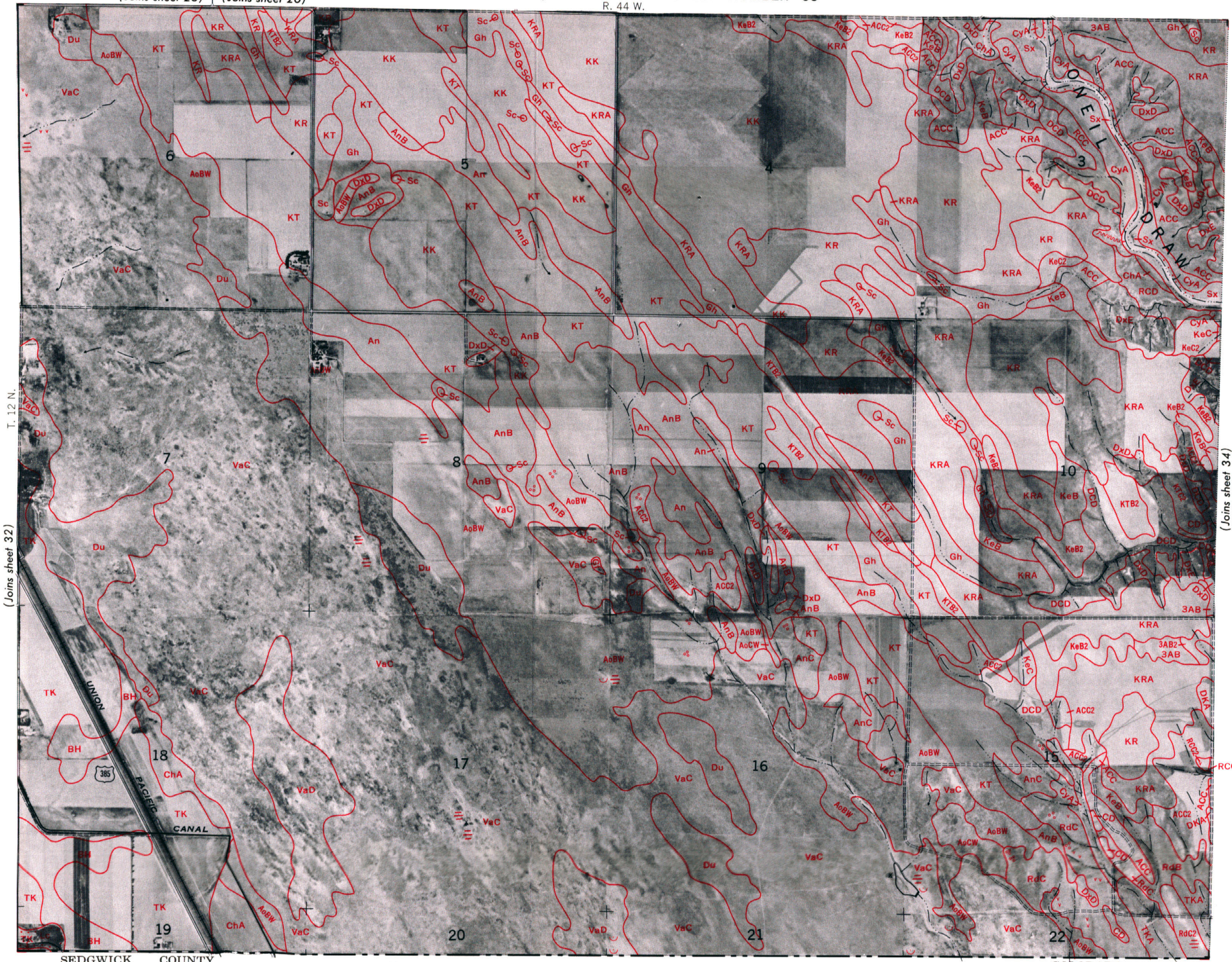
COLORADO

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

DEUEL COUNTY, NEBRASKA — SHEET NUMBER 33

(Joins sheet 25) | (Joins sheet 26)

33



(Joins sheet 32)

(Joins sheet 34)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

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Range, township, and section corners shown on this map are indefinite.

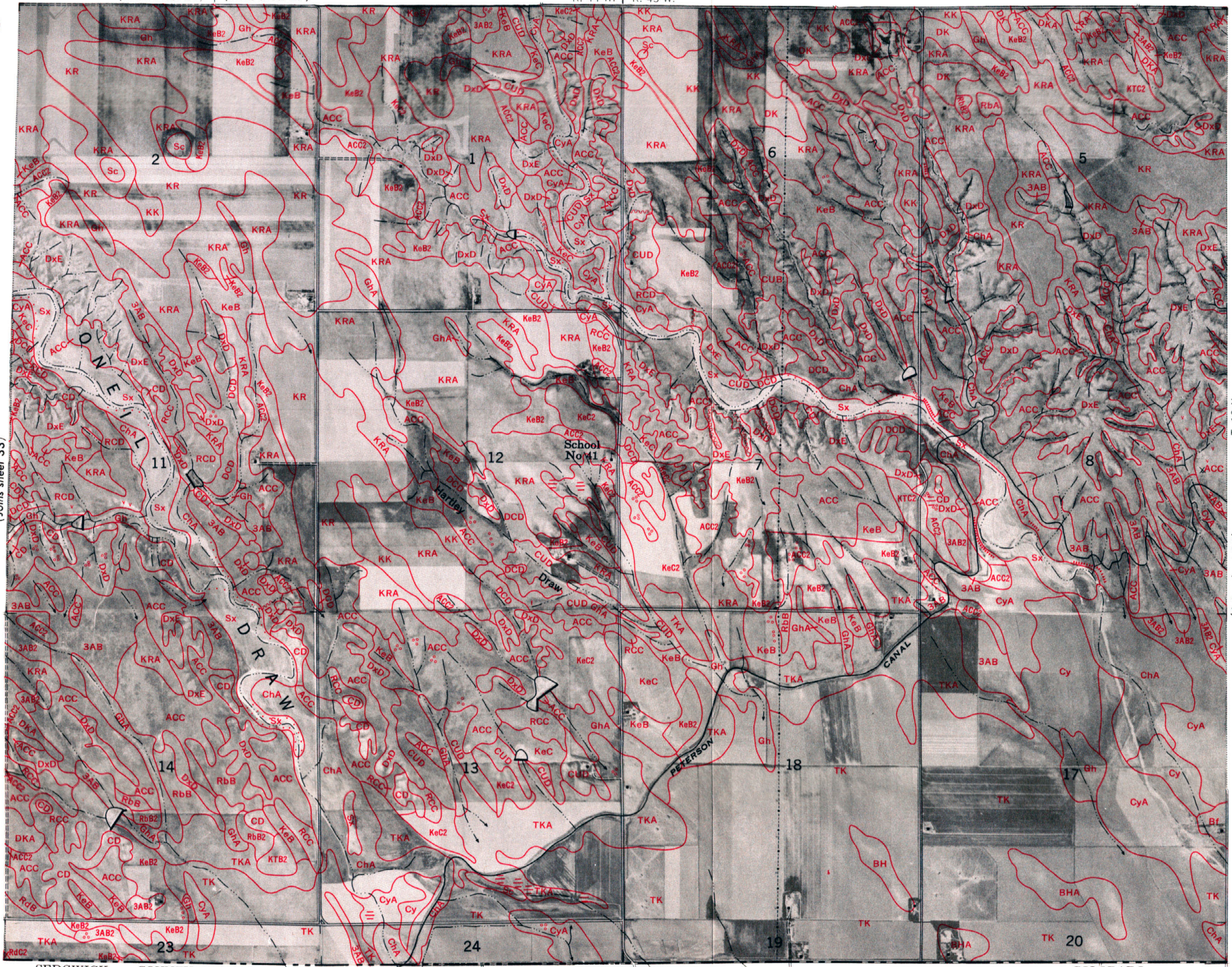
DEUEL COUNTY, NEBRASKA — SHEET NUMBER 34

(Joins sheet 26) | (Joins sheet 27)

R. 44 W. | R. 43 W.

N

(Joins sheet 33)



T. 12 N.

(Joins sheet 35)

SEDGWICK COUNTY

COLORADO

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

(Joins sheet 27) | (Joins sheet 28)

R. 43 W.

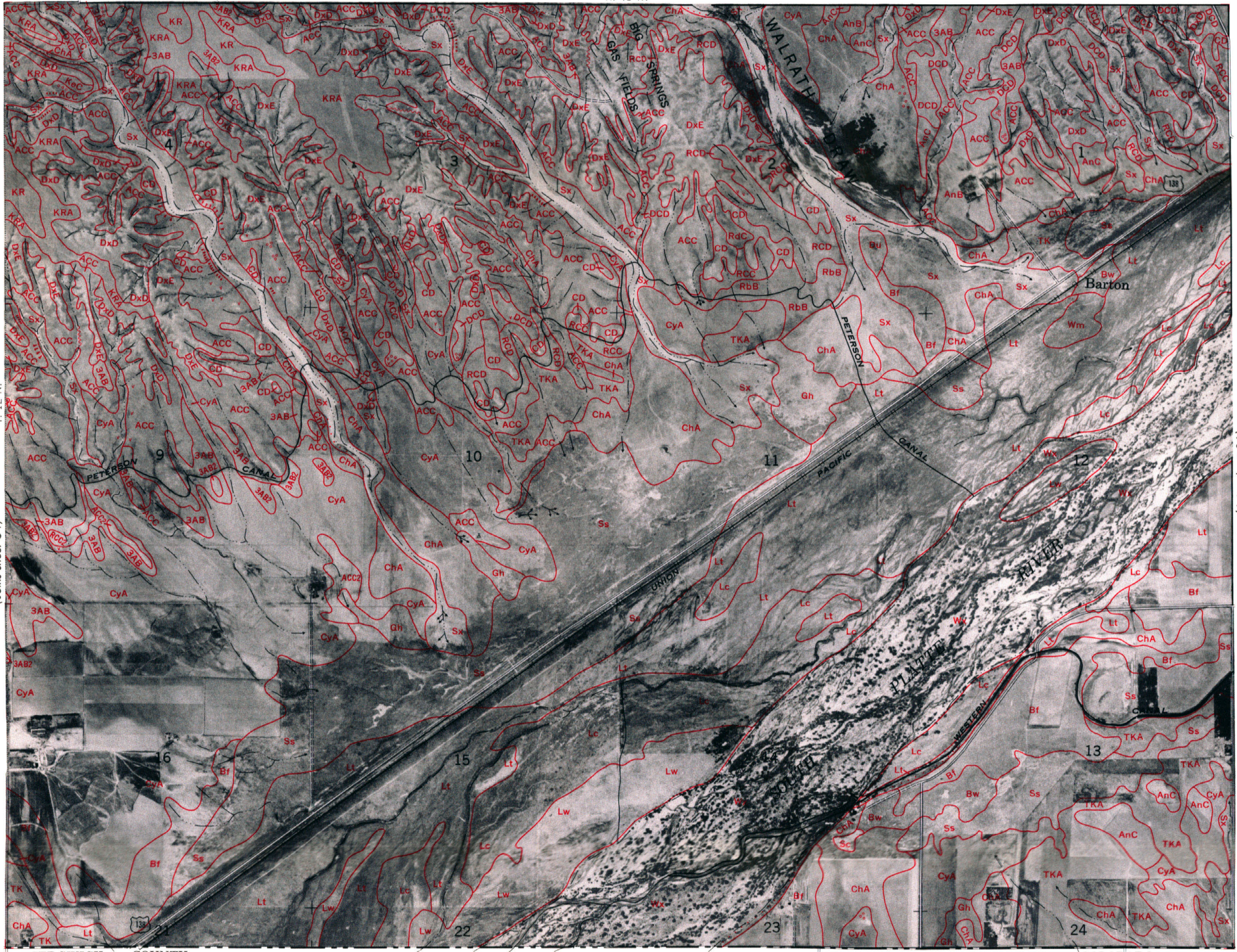
35

N

T. 12 N.

(Joins sheet 34)

(Joins sheet 36)



SEDGWICK COUNTY

COLORADO

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

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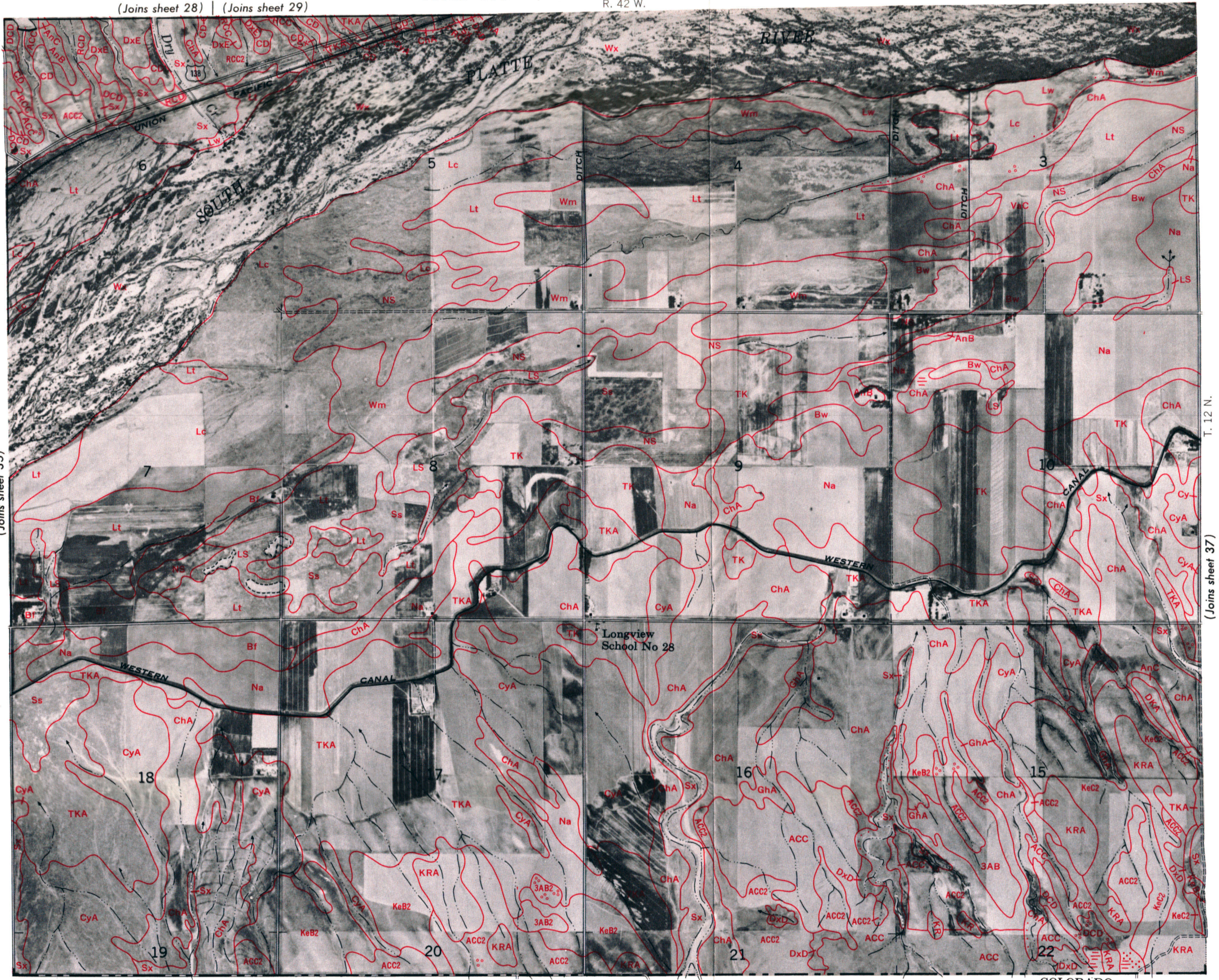
Range, township, and section corners shown on this map are indefinite.

DEUEL COUNTY, NEBRASKA — SHEET NUMBER 36

(Joins sheet 28) | (Joins sheet 29)

R. 42 W.

36



(Joins sheet 35)

(Joins sheet 37)

SEDGWICK COUNTY

COLORADO

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

37

(Joins sheet 29) | (Joins lower right)

R. 42 W.

T. 12 N.

(Joins sheet 36)

KEITH COUNTY

PERKINS COUNTY

SEDGWICK COUNTY COLORADO

0 ½ 1 Mile

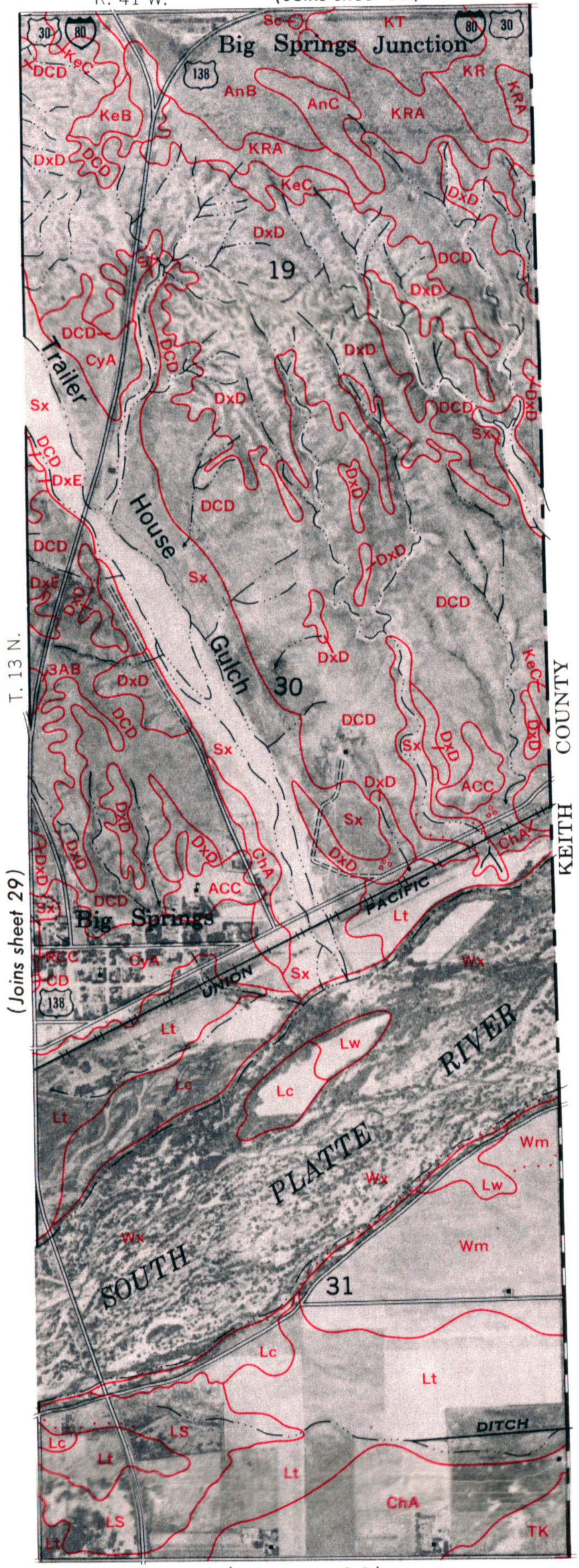
Scale 1:20 000

R. 41 W.

(Joins sheet 22)

T. 13 N.

(Joins sheet 29)



KEITH COUNTY

(Joins upper left)

0 5 000 Feet

N

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